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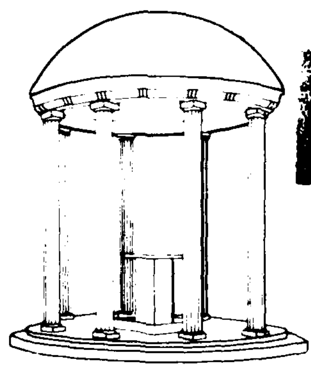

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1 AN EMPIRICAL COMPARISON OF TWO APPROXIMATELY OPTIMAL (s,S) INVENTORY POLICIES

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10 Richard Ehrhardt ~~and~~ George Kastner

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Decision Control Models in Operations Research

Harvey M. Wagner
Principal Investigator
School of Business Administration
University of North Carolina at Chapel Hill

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In this paper, we present an empirical comparison of two approximately optimal rules for computing (s,S) policies for single items under periodic review with a setup cost, linear holding and shortage costs, fixed replenishment lead time, and backlogging of unfilled demand. The Naddor Approximation, originally designed for holding and shortage costs based on period-average inventory levels, is transformed for use in a system where these costs are based on period-end inventory. It is compared empirically with

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the Power Approximation and with exactly optimal policies in a system of independent inventory items having 576 distinct parameter settings. The Power Approximation yields lower expected total costs than the Naddor Approximation in 456 of the 576 cases. The cost differences tend to be rather small, however. When total costs are aggregated over the entire system, the Power Approximation is 1.65% above optimal, as compared with 2.34% for the Naddor Approximation. Significant differences appear only when components of total cost are examined. The robustness of the policies is examined by analyzing their performance when statistical estimates are used in place of the actual mean and variance of demand. We also discuss the sensitivity to parameter settings of the performance of the two rules.

FOREWORD

As part of the on-going program in "Decision Control Models in Operations Research," Messrs. Richard Ehrhardt and George Kastner have investigated the relative merits of two approximately optimal (s,S) inventory policies. Both the Power Approximation and the Naddor Approximation are found to perform well in terms of total cost per period, although the Power Approximation has slightly lower cost on the average. The differences are found to be more pronounced, however, when components of total cost and backlog frequencies are compared. When viewed in this light, the Power Approximation is preferred, since it tends to more closely approximate the characteristics of optimal policies.

Other reports dealing with this research program are listed on the following pages.

Harvey M. Wagner
Principal Investigator

Richard Ehrhardt
Co-Principal Investigator

MacCormick, A. (1974), Statistical Problems in Inventory Control, ONR and ARO Technical Report 2, December 1974, School of Organization and Management, Yale University, 244 pp.

Estey, A. S. and R. L. Kaufman (1975), Multi-Item Inventory System Policies Using Statistical Estimates: Negative Binomial Demands (Variance/Mean = 9), ONR and ARO Technical Report 3, September 1975, School of Organization and Management, Yale University, 85 pp.

Ehrhardt, R. (1975), Variance Reduction Techniques for an Inventory Simulation, ONR and ARO Technical Report 4, September 1975, School of Organization and Management, Yale University, 24 pp.

Kaufman, R. (1976), Computer Programs for (s,S) Policies Under Independent or Filtered Demands, ONR and ARO Technical Report 5, School of Organization and Management, Yale University, 65 pp.

Kaufman, R. and J. Klincewicz (1976), Multi-Item Inventory System Policies Using Statistical Estimates: Sporadic Demands (Variance/Mean = 9), ONR and ARO Technical Report 6, School of Organization and Management, Yale University, 58 pp.

Ehrhardt, R. (1976), The Power Approximation: Inventory Policies Based on Limited Demand Information, ONR and ARO Technical Report 7, June 1976, School of Organization and Management, Yale University, 106 pp.

Klincewicz, J. G. (1976), Biased Variance Estimators for Statistical Inventory Policies, ONR and ARO Technical Report 8, August 1976, School of Organization and Management, Yale University, 24 pp.

Klincewicz, J. G. (1976), Inventory Control Using Statistical Estimates: The Power Approximation and Sporadic Demands (Variance/Mean = 9), ONR and ARO Technical Report 9, November 1976, School of Organization and Management, Yale University, 52 pp.

Klincewicz, J. G. (1976), The Power Approximation: Control of Multi-Item Inventory Systems with Constant Standard-Deviation-To-Mean Ratio for Demand, ONR and ARO Technical Report 10, November 1976, School of Business Administration and Curriculum in Operations Research and Systems Analysis, University of North Carolina at Chapel Hill, 47 pp.

Kaufman, R. L. (1977), (s,S) Inventory Policies in a Nonstationary Demand Environment, ONR and ARO Technical Report 11, April 1977, School of Business Administration and Curriculum in Operations Research and Systems Analysis, University of North Carolina at Chapel Hill, 155 pp.

Ehrhardt, R. (1977), Operating Characteristic Approximations for the Analysis of (s,S) Inventory Systems, ONR and ARO Technical Report 12, April 1977, School of Business Administration and Curriculum in Operations Research and Systems Analysis, University of North Carolina at Chapel Hill, 109 pp.

Schultz, C. R., R. Ehrhardt, and A. MacCormick (1977), Forecasting Operating Characteristics of (s,S) Inventory Systems, ONR and ARO Technical Report 13, December 1977, School of Business Administration and Curriculum in Operations Research and Systems Analysis, University of North Carolina at Chapel Hill, 47 pp.

Schultz, C. R. (1979), (s,S) Inventory Policies for a Wholesale Warehouse Inventory System, ONR Technical Report 14, April 1979, School of Business Administration and Curriculum in Operations Research and Systems Analysis, University of North Carolina at Chapel Hill, 75 pp.

Schultz, C. R. (1980), Wholesale Warehouse Inventory Control with Statistical Demand Information, ONR Technical Report 15, December 1980, School of Business Administration and Curriculum in Operations Research and Systems Analysis, University of North Carolina at Chapel Hill, 74 pp.

ABSTRACT

In this paper, we present an empirical comparison of two approximately optimal rules for computing (s,S) policies for single items under periodic review with a setup cost, linear holding and shortage costs, fixed replenishment lead time, and backlogging of unfilled demand. The Naddor Approximation, originally designed for holding and shortage costs based on period-average inventory levels, is transformed for use in a system where these costs are based on period-end inventory. It is compared empirically with the Power Approximation and with exactly optimal policies in a system of independent inventory items having 576 distinct parameter settings. The Power Approximation yields lower expected total costs than the Naddor Approximation in 456 of the 576 cases. The cost differences tend to be rather small, however. When total costs are aggregated over the entire system, the Power Approximation is 1.65% above optimal, as compared with 2.34% for the Naddor Approximation. Significant differences appear only when components of total cost are examined. The robustness of the policies is examined by analyzing their performance when statistical estimates are used in place of the actual mean and variance of demand. We also discuss the sensitivity to parameter settings of the performance of the two rules.

CONTENTS

1. INTRODUCTION

We consider a periodic review, single-item inventory system where unfilled demand is backlogged, there is a fixed lead time L between placement and delivery of an order, and demands during review periods are independent and identically distributed, having known mean μ and variance σ^2. Replenishment costs are comprised of a setup cost K and a unit cost c. At the end of each review period, a cost h or p is incurred for each unit on hand or backlogged, respectively. The criterion of optimality is minimization of the undiscounted expected cost per period over an infinite horizon.

Under these assumptions an (s,S) policy is optimal (Iglehart [2]). That is, whenever inventory on hand plus on order y is less than or equal to s, an order of size $S-y$ is placed. Iterative methods for computing optimal policies are available (Veinott and Wagner [5]), but unfortunately the computational effort required is prohibitive for practical implementation. Furthermore, the computation of an optimal policy requires the complete specification of the demand distribution, and this level of demand information is particularly unrealistic in practical situations. Most managers would be very fortunate if they had accurate knowledge of only the first two moments of the demand distribution.

In recent years, two approximately optimal policy rules have been proposed. Both are easily computed and require for demand information only the mean and variance. The policy of Naddor [4] is designed for use in a system which assesses holding and shortage costs against the average level of inventory in each period. We use Naddor's approach to

adjust the policy to a cost system based on period-end inventory and compare it with the Power Approximation of Ehrhardt [1]. Our comparison is based on costs incurred in a large inventory system of independent items having 576 distinct parameter settings. The primary criterion for comparing the rules is their deviations from optimal expected total cost per period. We also discuss the components of total cost, that is, holding cost, backlog cost, and replenishment cost.

We describe the policy rules in §2 and present our experimental design in §3. We analyze policy performance in §4 under the assumption that the mean and variance of demand are known. In §5 we analyze policy performance when the demand parameters are statistically estimated from a limited historical sample of demands. Finally we draw conclusions in §6.

2. THE POLICY RULES

The Power Approximation

The Power Approximation was derived by using existing results of asymptotic renewal theory to characterize the behavior of the optimal policy numbers as functions of the model parameters. These functions were then used to construct regressions with coefficients that were calibrated by using a grid of 288 known optimal policies as data. The resulting Power Approximation policies are easy to compute and require for demand information only the mean and variance of demand over lead time.

The Power Approximation is executed as follows. Let

$$D_p = (1.463)\mu^{.364}(K/h)^{.498}(\sigma_L)^{.138} \qquad (1)$$

and

$$s_p = (L + 1)\mu + (\sigma_L)^{.832}(\sigma^2/\mu)^{.187}(.220/z + 1.142 - 2.866z) , \quad (2)$$

where

$$z = \{D_p/[(1 + p/h)\sigma_L]\}^{.5} , \quad (3)$$

and

$$\sigma_L^2 = (L + 1)\sigma^2 . \quad (4)$$

If D_p/μ is greater than 1.5, let $s = s_p$ and $S = s_p + D_p$. Otherwise, the empirical modification of Wagner [6] is used. The modification is based on the observation of Wagner, O'Hagan, and Lundh [7] that as μ grows larger relative to K/h, the optimal policy converges to a single critical number which would be approximately optimal if K were equal to zero. The smaller of these two numbers is then used as S in the policy, thereby reducing the separation between S and s. The single critical number used is one which would be optimal if demand followed a normal distribution and K were equal to zero. Define S_0 as

$$S_0 = (L + 1)\mu + v\sigma_L , \quad (5)$$

where v is the solution to

$$\int_{-\infty}^{v} (2\pi)^{-.5}\exp(-x^2/2)dx = p/(p + h) . \quad (6)$$

The policy parameters are given by

$$s = \text{minimum}(s_p, S_0) \tag{7}$$

$$S = \text{minimum}(S_p, S_0) \ . \tag{8}$$

If demands are integer-valued, then s_p, D_p, and S_0 are rounded to the nearest integer.

The Naddor Approximation

Naddor considers t ree types of policies, denoted (t,Z), (s,q), and (s,S). In the (t,Z) policy, orders are permitted every t scheduling periods, at which times the level of inventory on hand plus on order is brought up to Z. The (s,q) policy prescribes an order of size q whenever inventory on hand plus on order falls below s, while the (s,S) policy specifies an order size $S - y$ whenever inventory on hand plus on order y falls below s.

Although the (t,Z) and (s,q) policies are not of an optimal form, they are considerably easier to analyze than the (s,S) policy. Naddor develops rules for approximating the best (t,Z) policy and the best (s,q) policy for a single-item inventory system. He then makes an observation, based on empirical results, that the optimal (s,S) policy is often quite close to a policy constructed by setting S equal to Z from the best (t,Z) policy, and using the s value from the best (s,q) policy. A detailed derivation of the Naddor Approximation is presented in the following paragraphs. The analysis differs from Naddor's [4] in that holding and shortage costs are assessed against period-end inventory rather than period-average inventory, allowing a more compact exposition.

We first develop an expression for Z_t^*, the best value of Z to use in a (t,Z) policy when the scheduling interval is fixed at the value t. Let $\{\xi_i, i=1,\ldots,t\}$, a sequence of i.i.d. non-negative random variables, denote the demands during a scheduling interval of length t, with $E(\xi_i) = \mu$ and $Var(\xi_i) = \sigma^2$. Also, let X_i be the level of inventory on hand and on order after satisfying demand in the ith period of the scheduling interval.

To facilitate the analysis, we assume that the demand distribution is continuous, with p.d.f. $\phi(\cdot)$ and c.d.f. $\Phi(\cdot)$. Let $c(t,Z)$ denote the total cost during a scheduling period t, when policy (t,Z) is used. We have, letting $H(x)$ be defined as 1 if x is positive and zero otherwise,

$$c(t,Z) = \sum_{i=1}^{t} \left[h\left(Z-\xi^{*(L+i)}\right)^{+} + p\left(\xi^{*(L+i)}-Z\right)^{+}\right] + KH\left(\xi^{*t}\right),$$

where $\xi^{*(L+i)}$ is the random demand during periods 1 through $L+i$, and thus $X_i = Z - \xi^{*(L+i)}$. Let $g_t(Z) = E[c(t,Z)]$ be the expected total cost during the scheduling interval,

$$g_t(Z) = \sum_{i=1}^{t} \left[h\int_0^Z (Z-u)d\Phi^{*(L+i)}(u) + p\int_Z^{\infty} (u-Z)d\Phi^{*(L+i)}(u)\right] + K\left[1-\Phi^{*t}(0)\right],$$

where $\Phi^{*j}(\cdot)$ is the j-fold convolution of $\Phi(\cdot)$. Notice that $g_t(Z)$ is a differentiable convex function, attaining a minimum value at Z_t^* such that $g_t'(Z_t^*) = 0$. Hence, we have

$$g_t'(Z_t^*) = \sum_{i=1}^{t} \left[h\Phi^{*(L+i)}(Z_t^*) - p + p\Phi^{*(L+i)}(Z_t^*)\right] = 0,$$

which yields

$$P(Z_t^*) \equiv (1/t) \sum_{i=1}^{t} \Phi^{*(L+i)}(Z_t^*) = p/(p+h) . \tag{9}$$

Notice that $P(\cdot)$ has all the properties of a c.d.f. The function $P(\cdot)$ is therefore identified as the c.d.f. of an *equivalent demand distribution* with mean m_1 and variance v_1, which are computed as follows:

$$m_1 = \int_0^\infty u dP(u) = 1/t \sum_{i=1}^{t} \int_0^\infty u d\Phi^{*(L+i)}(u)$$

$$m_1 = [L + (t+1)/2]\mu . \tag{10}$$

Similarly,

$$v_1 + m_1^2 = \int_0^\infty u^2 dP(u) = 1/t \sum_{i=1}^{t} \int_0^\infty u^2 d\Phi^{*(L+i)}(u) ,$$

which yields

$$v_1 + m_1^2 = \sigma^2[L + (t+1)/2] + \mu^2[L^2 + L(t+1) + (t+1)(2t+1)/6] ,$$

and

$$v_1 = [L + (t+1)/2]\sigma^2 + [(t^2-1)/2]\mu^2 , \tag{11}$$

Note that if the scheduling period t equals 1, then (10) and (11) reduce to $m_1 = (L+1)\mu$ and $v_1 = (L+1)\sigma^2$ respectively, which are the correct mean and variance of the demand distribution during the lead time.

We develop an approximate value of Z_t^* by replacing $P(\cdot)$ in (9) with a normal distribution having mean m_1 and variance v_1, yielding

$$Z_t^* \doteq m_1 + \sqrt{v_1}\, F^{-1}[p/(p+h)] \ , \tag{12}$$

where $F(\cdot)$ is the standard normal cumulative distribution function. Finally, we assume that the optimal value of t is close to t^*, the duration of the optimal lot size in a continuous review system with deterministic demand, namely

$$t^* = [2K(1+h/p)/\mu h]^{.5} \ . \tag{13}$$

Combining (10), (11), and (12), we have the Naddor Approximation for S:

$$S_N = [L + (t^*+1)/2]\mu + \{[L + (t^*+1)/2]\sigma^2 + [(t^{*2}-1)/12]\mu^2\}^{.5}F^{-1}[p/(p+h)]. \tag{14}$$

where t^* is given by (13).

Now we develop the Naddor Approximation for s by analyzing the (s,q) policy. Let $C_q(a)$ by the expected cost per period when an (s,q) policy is followed with $A \equiv s+q$. Also, let $B(\cdot)$ be the long-run distribution of inventory-on-hand-and-on-order after ordering, which is uniform on $(s,s+q]$. We have

$$C_q(A) = \int_{A-q}^{A}\left[h\int_0^y (y-x)d\Phi^{*(L+1)}(x) + p\int_y^\infty (x-y)d\Phi^{*(L+1)}(x) + K\int_{y-A+q}^\infty d\Phi(x)\right]dB(y) \ .$$

After some manipulation, we get

$$C_q(A) = \int_0^q\left\{(h+p)\int_0^{y+A-q}(y+A-q-x)d\Phi^{*(L+1)}(x) + p[(L+1)\mu-y-A+q] + K[1-\Phi(y)]\right\}dB(y+A-q) \ .$$

We next show that $C_q(A)$ and its minimizing argument depend on whether the uniform distribution $B(\cdot)$ is continuous or discrete. Naddor [4] makes no mention of this point. Hence, we suggest that his policy might be improved by doing so.

If demand is continuously distributed, $C_q(A)$ is differentiable and convex, attaining a minimum value at A_q^* such that $C_q'(A_q^*) = 0$. Hence we have

$$0 = \int_0^q \left[(h+p)\Phi^{*(L+1)}(y+A_q^*-q) - p\right] dB(y+A_q^*-q)$$

$$= \int_0^q \left[(h+p)\Phi^{*(L+1)}(y+A_q^*-q) - p\right] dy/q \ .$$

Therefore,

$$Q(A_q^*) \equiv (1/q)\int_0^q \Phi(y+A_q^*-q)dy = p/(h+p) \ . \tag{15}$$

Notice that $Q(\cdot)$ in (15) has all the properties of a c.d.f. The function $Q(\cdot)$ is therefore identified as the c.d.f. of an *equivalent demand distribution* having mean m_2 and variance v_2. To compute m_2, we evaluate

$$m_2 = \int_{-\infty}^{\infty} x dQ(x) = \frac{1}{q}\int_0^q \int_{-\infty}^{\infty} x d\Phi^{*(L+1)}(x+y-q)dy \ ,$$

$$m_2 = (L+1)\mu + q/2 \ . \tag{16}$$

Similarly, we have

$$v_2 + m_2^2 = \int_{-\infty}^{\infty} x^2 dQ(x) = \frac{1}{q}\int_0^q \int_{-\infty}^{\infty} x^2 d\Phi^{*(L+1)}(x+y-q)dy$$

$$= (L+1)\sigma^2 + (L+1)^2\mu^2 + (L+1)\mu q + q^2/3 \ ,$$

$$v_2 = (L+1)\sigma^2 + q^2/12 \ . \tag{17}$$

When demand follows a discrete distribution, a similar line of analysis leads to new versions of (15), (16), and (17). The quantity A_q^* is now defined as the smallest value satisfying

$$R(A_q^*) \equiv (1/q) \sum_{y=1}^{q} \Phi^{*(L+1)}(y+A_q^*-q) \geq p/(h+p) . \qquad (18)$$

The equivalent demand distribution $R(\cdot)$ has mean and variance m_3 and v_3, given by

$$m_3 = (1/q) \sum_{y=1}^{q} \int_{-\infty}^{\infty} x d\Phi^{*(L+1)}(x-y)$$

$$= (L+1)\mu + (q+1)/2 , \qquad (19)$$

and

$$v_3 = (1/q) \sum_{y=1}^{q} \int_{-\infty}^{\infty} x^2 d\Phi^{*(L+1)}(x-y) - m_3^2$$

$$= (L+1)\sigma^2 + (q^2-1)/12 . \qquad (20)$$

In our study we use discrete demand distributions to compare policies, so we will use (18), (19), and (20) to characterize the equivalent demand for the (s,q) policy.

We develop an approximate value of A_q^* by replacing $R(\cdot)$ in (18) with a normal distribution having mean m_3 and variance v_3, yielding

$$A_q^* \doteq m_3 + \sqrt{v_3} F^{-1}[p/(p+h)] , \qquad (21)$$

where $F(\cdot)$ is the standard normal cumulative distribution function. Finally, we assume that the optimal value of q is close to $q^* = \mu t^*$, the optimal lot size in a continuous review system with deterministic demand. An expression for t^* is given in (13). Combining (19), (20), and (21), we get the Naddor Approximation for s

$$s_N = (L+1)\mu + (1-q^*)/2 + [(L+1)\sigma^2 + (q^2-1)/12]^{.5}F^{-1}[p/(p+h)] , \quad (22)$$

where

$$q^* = [2K\mu(1+h/p)/h]^{.5} . \quad (23)$$

For convenience, we rewrite (14) here as

$$S_N = (L+1)\mu + (q-\mu)/2$$
$$+ [(L+1)\sigma^2 - \sigma^2/2 + (q^2-\mu^2)/12 + q^2\sigma^2/2\mu]^{.5}F^{-1}[p/(p+h)] . \quad (24)$$

The Naddor Approximation is given by (22), (23), and (24). When demand is integer-valued, s_N and S_N are rounded to the nearest integer values.

3. EXPERIMENTAL DESIGN

We compare the policies by computing their associated expected costs per period for a large number of items and assessing their performance relative to optimal policies. Specifically, we use a system of 576 independent items to compute expected costs for Power Approximation, Naddor Approximation, and optimal policies. Since the Power Approximation was derived using regression analysis, we were careful to choose parameter settings that were different from those used to provide data for the regression fits (see [1]).

Table 1 lists the parameter settings for the system. Three different categories of demand distributions are considered; Poisson, and negative binomial with variance-to-mean ratios of 3 and 9. In each category, demand is given four different mean values: 3, 7, 11, and 15. Three values, 0, 2, and 4, are assigned to the replenishment lead time. Since the cost function is linear in the parameters K, p, and h, the value of the holding cost h is normalized at unity. The unit penalty costs are 3, 9, 27, and 81, and the set-up cost values are 8, 16, 32, and 64. All combinations of these parameter settings are included in the system, yielding a complete factorial design with a total of 576 different combinations/items.

We use the software package of Kaufman [3] to compute an optimal policy for each of the 576 items and to compute the expected values of costs for the optimal, *Power Approximation*, and *Naddor Approximation* policies. The package utilizes the algorithm of Veinott and Wagner [5].

TABLE 1

System Parameters Selection

Factor	Levels	Number of Levels
Demand distribution	Poisson ($\sigma^2/\mu = 1$)	3
	Negative Binomial ($\sigma^2/\mu = 3$)	
	Negative Binomial ($\sigma^2/\mu = 9$)	
Mean demand (μ)	3, 7, 11, 15	4
Replenishment lead time (L)	0, 2, 4	3
Replenishment setup cost (K)	8, 16, 32, 64	4
Unit penalty cost (p)	3, 9, 27, 81	4
Unit holding cost (h)	1	1

4. POLICY PERFORMANCE: KNOWN MEAN AND VARIANCE OF DEMAND

In Table 2 we list the components of aggregate expected costs per period in the 576-item system. The Power Approximation and Naddor Approximation are also compared with optimal policies by including percentage excesses over optimal costs in parentheses.

TABLE 2

Aggregate Expected Costs per Period in a 576-Item System Under Approximately Optimal Control

(Figures in parentheses are percentages above optimal costs.)

Cost Component	Naddor Approximation σ^2/μ 1	3	9	Power Approximation σ^2/μ 1	3	9
Holding	2573 (7.1)	3476 (0.6)	5334 (-3.9)	2317 (-3.6)	3347 (-3.2)	5587 (0.7)
Backlog	331 (-38.9)	821 (-15.5)	2225 (13.7)	525 (-3.0)	1046 (7.7)	1973 (0.8)
Replenishment	1976 (10.2)	1803 (13.2)	1516 (13.6)	1946 (8.5)	1694 (6.4)	1441 (8.0)
Total	4880 (3.0)	6100 (1.3)	9074 (2.6)	4788 (1.1)	6087 (1.1)	9001 (1.8)

Notice in Table 2 that both the Power Approximation and Naddor Approximation perform well, with aggregate total costs ranging from 1.1% to 3.0% above optimal values. The aggregate total cost per period for the Power Approximation is closer to optimal values for all settings of variance-to-mean ratio, σ^2/μ. The greatest difference between the approximately optimal policies is for the portion of the system having

σ^2/μ equal to 1, where the Power Approximation yields total costs 1.1% above optimal, as compared with 3.0% above optimal for the Naddor Approximation. The general pattern in Table 2 is that the Power Approximation yields aggregate costs that are closer to optimal for nearly every cost component and variance-to-mean ratio value. The most striking departure from optimality occurs for the Naddor Approximation and a variance-to-mean ratio of 1. In this case we see that holding cost is 7.1% above optimal, backlog cost is 38.9% below optimal, and replenishment cost is 10.2% above optimal. The departures from optimality are somewhat offsetting, however, as total cost is only 3.0% above optimal.

Detailed listings of policies and costs for each of the 576 items are given in Appendices A through D. The most significant observation to be made from the listings is that the Power Approximation total cost is less than or equal to the Naddor Approximation cost for 459 out of the 576 items considered.

Sensitivity to Parameter Settings

Comparisons of optimal and approximately optimal control, expanding on Table 2, are given in Tables 3 through 6. The tables display percentages above optimality for each cost component and each policy rule. The percentages in Tables 3 through 6 are computed by averaging single-item percentages above optimality over all items in each category. We emphasize that these measures are different from the percentages in Table 2, which are percentage differences between aggregate costs. The figures in Tables 3 through 6 are segregated by the settings of K/h and σ^2/μ, which we found to be the two most significant parameters in comparing the policies.

TABLE 3

Average Percentages Above Optimal Total Costs Per Period for a 576-Item System Under Approximately Optimal Control

	Naddor Approximation		Power Approximation	
σ^2/μ	K/h = 8, 16	K/h = 32, 64	K/h = 8, 16	K/h = 32, 64
1	4.0	2.5	2.2	0.4
3	2.2	1.1	2.3	0.2
9	4.0	1.8	3.4	0.2

TABLE 4

Average Percentages Above Optimal Holding Costs Per Period for a 576-Item System Under Approximately Optimal Control

	Naddor Approximation		Power Approximation	
σ^2/μ	K/h = 8, 16	K/h = 32, 64	K/h = 8, 16	K/h = 32, 64
1	11.0	7.5	-9.0	0.5
3	2.5	5.2	-4.5	-2.5
9	3.1	7.3	6.4	0.3

TABLE 5

Average Percentages Above Optimal Backlog Costs Per Period for a 576-Item System Under Approximately Optimal Control

	Naddor Approximation		Power Approximation	
σ^2/μ	K/h = 8, 16	K/h = 32, 64	K/h = 8, 16	K/h = 32, 64
1	-44.5	-47.4	-0.5	-4.2
3	-10.2	-24.5	9.0	5.4
9	22.8	-1.1	0.8	-0.2

TABLE 6

Average Percentages Above Optimal Replenishment Costs Per Period for a 576-Item System Under Approximately Optimal Control

	Naddor Approximation		Power Approximation	
σ^2/μ	K/h = 8, 16	K/h = 32, 64	K/h = 8, 16	K/h = 32, 64
1	19.3	7.4	22.2	1.7
3	25.1	8.4	17.8	0.9
9	27.1	7.7	24.5	1.3

The most obvious pattern in Tables 3 through 6 is that both policies perform better for the high values of setup cost. The difference is more pronounced for the Power Approximation, which is quite close to optimality in all cost components when only the high values of setup cost are considered. When the low values of setup cost are considered, it appears that the major failing of the Power Approximation is a tendency to order too frequently (see Table 6). This is probably due to an inaccuracy in Wagner's empirical modification [expressions (5) through (8)], which comes into play only in this portion of the system.

The Naddor Approximation also exhibits better performance for the high values of setup cost, but there is a pattern in Tables 3 through 6 which holds for all setup cost values. The pattern is one of significant departure from optimal values of the components of total cost. Notice the high holding and replenishment cost values and the low backlog cost values. The only exception to this pattern is for $\sigma^2/\mu = 9$, where backlog costs are significantly above optimal for low setup costs, and only slightly below optimal for high setup costs.

5. POLICY PERFORMANCE: ESTIMATED MEAN AND VARIANCE OF DEMAND

We have compared the Power and Naddor Approximations assuming that the mean and variance of demand are accurately specified. In a typical applied setting, however, demand parameters are estimated from a limited history of observed past demands. In this situation the concept of an optimal policy is not well defined. We suggest using an (s,S) policy that is computed by substituting estimates of the demand mean and variance in place of the actual mean and variance in the expressions for policy computation. We next analyze the performance of the Power and Naddor Approximations when demand estimates are used in place of actual values. Each policy is also compared with the optimal policy which could be computed if the demand distribution were completely specified.

Specifically, we assume that a history of n demands is used in setting the policy to be employed over the subsequent n periods and that during this interval of $2n$ periods the demand distribution parameters remain unchanged. (In other words, we assume it is warranted to use the past n observed demands to estimate the mean and variance of demand for the next n periods.) The demand history is used to calculate a sample mean and sample variance which are substituted in place of μ and σ^2 in expressions (1) through (8) (if the Power Approximation is used) or expressions (22) through (24) (if the Naddor Approximation is used).

The mathematical complexity underlying this procedure of policy determination necessitates our using a simulation program to evaluate policy performance. Specifically, we make 200 replications of this policy computation for each group of parameter settings: we examine a

72-item system with Poisson demand distributions. Values of mean demand are 2, 4, 8, and 16, setup costs are 32 and 64, unit penalty costs values are 4, 9, and 99, and lead time is set at 0, 2, and 4. Demand history length values n are 26 and 52 (corresponding to a half and full year of weekly data). The simulation program computes estimates of expected cost components for each item in the system and aggregates the costs to produce estimates of system-wide performance.

Table 7 shows estimates of percentage increases in aggregate expected total cost per period when statistical control is compared with optimal control given full information. Also given in Table 7 are percentage increases in expected total cost per period when exact (constant) values of μ and σ^2 are used to compute the policies. These figures are given in rows marked with "∞ Periods" for demand history length.

Several conclusions emerge from the data in Table 7. First, the differences in costs between the two policies are quite small. In this system, the Power Approximation costs are consistently lower than the Naddor Approximation costs, but usually by no more than a few percent. Second, the Naddor Approximation appears to be more sensitive to changes in parameter settings, but the differences between the policies are rather small in this dimension as well. Similar patterns are observed in systems with demand distributions having larger variances, but the differences between the policies are even smaller. For example, in a 72-item system under statistical control with negative binomial demand having σ^2/μ equal to 9, the two policies produce aggregate total costs within a percent of one another. The Power Approximation has lower costs for unit penalty costs of 4 and 9, while the Naddor Approximation has lower costs for the unit penalty cost of 99.

TABLE 7

Percentages Above Optimal Full Information Total Costs for a 72-Item System Under Statistical Control

Decision Rule and Demand History Length	Total Aggregate Cost	Costs Aggregated by Parameter Value											
		Penalty Cost			Setup Cost		Lead Time			Mean Demand			
		4	9	99	32	64	0	2	4	2	4	8	16
Naddor Approximation													
26 Periods	3.9	1.6	2.4	6.7	4.0	3.8	4.6	3.2	3.8	5.6	4.6	3.7	3.0
52 Periods	3.2	1.2	1.7	5.9	3.2	3.2	4.5	2.6	2.7	5.1	3.7	3.1	2.3
∞ Periods	2.7	0.7	1.0	5.6	2.5	2.9	4.4	2.2	1.7	4.8	3.3	2.4	1.9
Power Approximation													
26 Periods	2.3	1.5	1.6	3.4	2.9	1.8	1.0	2.2	3.4	2.2	2.4	2.1	2.3
52 Periods	1.4	1.0	0.9	2.1	1.8	1.1	1.0	1.2	1.9	1.2	1.5	1.5	1.4
∞ Periods	0.4	0.4	0.2	0.5	0.6	0.2	0.6	0.3	0.3	0.4	0.2	0.1	0.6

The major differences between the policies are seen only when operating characteristics other than total cost are examined. Similar patterns are observed for the operating characteristics of statistically controlled policies as were observed for the case of known mean and variance of demand. That is, the Naddor Approximation has a greater tendency to produce excess holding and replenishment costs while producing low backlog costs. This point is illustrated by the behavior of yet another operating characteristic: the frequency of periods in which backlogs exist. Table 8 lists percentages above optimal backlog frequencies for the same 72-item system described by Table 7.

The most significant pattern in Table 8 is that the Naddor Approximation produces substantially smaller backlog frequencies than optimal policies. This observation holds for all parameter groupings in Table 8. The Power Approximation also tends to produce low backlog frequencies, but not for all parameter groupings. It is closer to optimal policy performance than the Naddor Approximation for all groupings in Table 8 except for the mean demand value of 16. When higher variance systems are examined, there is a tendency for both policies to display higher backlog frequencies relative to optimal policies. For example, in a 72-item system with negative binomial demand having σ^2/μ equal to 9, the Power Approximation produces backlog frequencies that are consistently greater than optimal policy values. The Naddor Approximation produces backlog frequencies above optimal only for p/h equal 99 or L equal 4. In this system, the Power Approximation is consistently closer to optimal for demand history lengths greater than 26 periods. When demand history length is 26 periods, the Power Approximation averages 12.2% above optimal backlog

TABLE 8

Percentages Above Optimal Full Information Backlog Frequencies for a 72-Item System Under Statistical Control

Decision Rule and Demand History Length	Total System	Frequencies Aggregated by Parameter Value											
		Penalty Cost			Setup Cost		Lead Time			Mean Demand			
		4	9	99	32	64	0	2	4	2	4	8	16
Naddor Approximation													
26 Periods	-19.8	-15.2	-25.9	-59.4	-22.6	-17.0	-27.1	-17.[illegible]	-15.1	-40.5	-25.1	-12.5	-3.3
52 Periods	-21.5	-16.3	-28.1	-71.0	-25.4	-17.7	-26.0	-16.9	-17.9	-41.7	-26.3	-14.5	-6.2
∞ Periods	-23.2	-17.0	-31.5	-76.0	-27.3	-19.1	-27.5	-19.6	-22.4	-43.4	-23.9	-16.3	-6.6
Power Approximation													
26 Periods	-2.0	-6.0	3.5	31.1	-2.2	-1.8	-14.9	2.5	6.0	1.1	2.3	-1.1	-9.7
52 Periods	-3.7	-7.2	2.0	16.3	-4.6	-2.8	-14.9	1.1	2.6	-1.0	1.0	-2.6	-11.4
∞ Periods	-6.1	-9.2	0.6	-7.9	-6.8	-5.4	-14.7	-3.6	-0.3	-4.6	-0.3	-4.3	-14.2

frequency while the Naddor Approximation averages 12.9% below optimal. In this case, neither policy is consistently closer to optimal policy performance.

6. CONCLUDING REMARKS

We have compared two approximately optimal rules for computing (s,S) policies. Both are easily computed, require demand information only in the form of mean and variance, and provide expected total costs that are quite close to optimal. The greatest differences between the policies appear when we examine characteristics other than total cost, such as backlog frequency and components of total cost. For these characteristics, the Power Approximation is significantly closer to optimal policy performance.[1]

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APPENDIX A

Single-Item Policies and Costs

In this appendix, the listed items are ordered by the values of economic and demand parameters (L, K/h, p/h, μ, σ^2/μ).

COMPARISON OF OPT. POWER & NADDOR APPROXIMATIONS

VARIANCE-TO-MEAN RATIO = 1

******* O R I G I N A L   O R D E R *******

IN THIS TABLE SET-UP COSTS ARE: 8 AND 16

EXP.COST IS EXP. TOTAL COST

L	M	PI	K	OPTIMAL POLICY (S,S)	OPTIMAL POLICY EXP.COST	POWER APPROXIMATION (S,S)	POWER APPROXIMATION EXP.COST	POWER APPROXIMATION ERROR	NADDOR APPROXIMATION (S,S)	NADDOR APPROXIMATION EXP.COST	NADDOR APPROXIMATION ERROR	COMPARISON NAD-POW	COMPARISON ND<PW
0	3	3	8	(0, 9)	6.55	(1, 8)	6.59	0.63	(2, 8)	6.94	5.92	5.28	
0	7	3	8	(3, 13)	9.36	(4, 9)	10.68	7.20	(5, 13)	10.29	3.23	-3.98	•
0	11	3	8	(7, 14)	12.19	(7, 13)	12.21	0.22	(8, 17)	12.81	5.19	4.97	
0	15	3	8	(10, 18)	13.05	(11, 18)	13.05	0.00	(11, 20)	13.69	4.93	4.93	
0	3	9	8	(2, 9)	7.26	(3, 10)	8.06	2.64	(4, 9)	8.60	9.49	6.85	
0	7	9	8	(6, 16)	11.96	(7, 10)	12.84	7.32	(8, 15)	12.67	5.89	-1.44	•
0	11	9	8	(10, 15)	14.13	(10, 15)	14.13	0.0	(12, 19)	15.52	9.85	9.65	
0	15	9	8	(15, 20)	15.12	(14, 20)	15.12	0.00	(16, 22)	15.74	4.13	4.12	
0	3	27	8	(4, 10)	9.09	(4, 11)	9.13	0.50	(5, 11)	9.58	5.44	4.93	
0	7	27	8	(8, 14)	13.73	(9, 12)	14.21	3.50	(10, 16)	14.63	6.58	3.08	
0	11	27	8	(13, 17)	15.88	(13, 17)	15.88	0.0	(14, 20)	16.96	6.77	6.77	
0	15	27	8	(16, 22)	17.13	(17, 22)	17.13	0.00	(19, 23)	17.22	0.48	0.48	
0	3	81	8	(5, 11)	10.13	(5, 12)	10.17	0.40	(6, 12)	10.57	4.36	3.96	
0	7	81	8	(10, 19)	15.25	(11, 13)	15.79	3.52	(12, 18)	16.45	7.82	4.30	
0	11	81	8	(15, 19)	17.46	(15, 18)	17.93	2.65	(17, 22)	19.01	8.86	6.21	
0	15	81	8	(20, 24)	18.97	(20, 24)	18.97	0.0	(22, 25)	19.05	0.45	0.45	
2	3	3	8	(6, 13)	7.46	(7, 14)	7.68	0.28	(9, 15)	8.29	8.16	7.88	
2	7	3	8	(18, 24)	11.60	(19, 24)	12.70	9.51	(20, 28)	12.10	4.31	-5.20	•
2	11	3	8	(29, 42)	14.53	(30, 37)	15.08	3.81	(31, 40)	15.02	3.40	-0.41	•
2	15	3	8	(40, 50)	16.56	(42, 50)	16.60	0.25	(43, 52)	16.98	2.53	2.27	
2	3	9	8	(9, 17)	9.61	(9, 16)	9.63	0.14	(11, 17)	10.10	5.13	4.99	
2	7	9	8	(22, 32)	14.55	(22, 27)	15.59	7.18	(24, 31)	15.33	5.36	-1.81	•
2	11	9	8	(34, 41)	18.21	(34, 40)	18.34	0.70	(36, 43)	18.66	2.46	1.76	
2	15	9	8	(45, 54)	20.10	(45, 54)	20.10	0.0	(48, 55)	20.27	0.84	0.84	
2	3	27	8	(11, 19)	11.43	(12, 19)	11.50	0.61	(13, 18)	11.98	4.82	4.21	
2	7	27	8	(25, 35)	17.19	(25, 29)	18.40	7.01	(27, 33)	18.17	5.68	-1.33	•
2	11	27	8	(38, 44)	21.14	(38, 43)	21.29	0.70	(40, 46)	21.71	2.69	1.99	
2	15	27	8	(51, 57)	23.40	(51, 57)	23.40	0.0	(53, 58)	23.41	0.07	0.07	
2	3	81	8	(13, 20)	13.32	(14, 21)	13.21	1.44	(15, 20)	13.75	5.55	4.11	
2	7	81	8	(28, 37)	19.59	(28, 31)	20.88	6.56	(29, 35)	20.24	3.28	-3.28	•
2	11	81	8	(41, 47)	23.78	(42, 46)	23.87	0.39	(43, 49)	24.46	2.86	2.47	
2	15	81	8	(55, 63)	26.34	(55, 60)	26.44	0.36	(56, 61)	26.35	0.01	-0.35	•
4	3	3	8	(13, 21)	8.53	(13, 20)	8.63	1.22	(15, 21)	9.01	5.66	4.44	
4	7	3	8	(32, 44)	12.30	(33, 44)	12.97	0.53	(35, 43)	13.60	5.36	4.83	
4	11	3	8	(51, 60)	16.12	(53, 60)	17.16	6.44	(54, 63)	16.89	4.79	-1.65	•
4	15	3	8	(71, 83)	18.91	(73, 81)	19.05	0.78	(74, 83)	19.25	1.82	1.04	
4	3	9	8	(16, 24)	10.30	(16, 23)	10.94	0.39	(18, 24)	11.43	4.81	4.42	
4	7	9	8	(37, 48)	16.49	(37, 48)	16.49	0.0	(39, 46)	17.20	4.30	4.30	
4	11	9	8	(57, 71)	20.65	(57, 65)	21.01	1.74	(60, 67)	21.39	3.59	1.86	
4	15	9	8	(76, 86)	23.51	(78, 86)	23.51	0.0	(80, 88)	23.74	0.96	0.96	
4	3	27	8	(19, 26)	13.12	(19, 26)	13.12	0.0	(20, 26)	13.41	2.21	2.21	
4	7	27	8	(41, 51)	19.74	(41, 52)	19.77	0.16	(43, 49)	20.73	5.05	4.88	
4	11	27	8	(62, 70)	24.73	(62, 69)	24.92	0.79	(64, 71)	25.04	1.26	0.47	
4	15	27	8	(84, 91)	27.66	(83, 91)	27.67	0.04	(86, 92)	27.78	0.44	0.40	
4	3	81	8	(21, 28)	15.08	(22, 29)	15.34	1.75	(22, 28)	15.32	1.61	-0.14	•
4	7	81	8	(44, 54)	22.63	(45, 56)	22.88	1.07	(46, 52)	23.51	3.89	2.82	
4	11	81	8	(66, 73)	28.07	(67, 72)	28.14	0.22	(68, 74)	28.32	0.89	0.67	
4	15	81	8	(89, 95)	31.41	(89, 94)	31.61	0.64	(90, 96)	31.50	0.28	-0.36	•
0	3	3	16	(0, 10)	8.89	(0, 9)	8.93	0.42	(1, 10)	9.15	2.88	2.46	

0	7	3	16	(2, 16)	13.51	(3, 17)	13.59	0.60	(3, 17)	13.59	0.60	0.0	
0	11	3	16	(5, 22)	16.79	(6, 13)	19.64	16.91	(6, 21)	16.94	0.86	-16.06	*
0	15	3	16	(8, 30)	19.57	(9, 18)	20.80	6.32	(9, 26)	20.08	2.62	-3.70	*
0	3	9	16	(2, 11)	10.36	(2, 11)	10.36	0.0	(3, 12)	10.72	3.48	3.48	
0	7	9	16	(5, 19)	15.72	(6, 20)	15.83	0.66	(7, 19)	16.10	2.39	1.73	
0	11	9	16	(9, 25)	19.47	(9, 15)	21.92	12.54	(11, 24)	20.09	3.15	-9.39	*
0	15	9	16	(13, 33)	22.66	(13, 20)	23.08	1.87	(14, 28)	24.23	6.95	5.08	
0	3	27	16	(3, 13)	11.61	(4, 13)	11.77	1.37	(5, 14)	12.41	6.89	5.52	
0	7	27	16	(8, 20)	17.56	(8, 22)	17.65	0.49	(10, 21)	18.50	5.35	4.86	
0	11	27	16	(12, 28)	21.70	(12, 17)	23.79	9.63	(14, 26)	22.80	5.07	-4.56	*
0	15	27	16	(16, 22)	25.12	(16, 22)	25.12	0.0	(18, 31)	27.58	9.80	9.80	
0	3	81	16	(5, 14)	12.80	(5, 14)	12.80	0.0	(7, 15)	14.25	11.29	11.29	
0	7	81	16	(10, 22)	19.19	(10, 24)	19.33	0.72	(12, 23)	20.35	6.03	5.31	
0	11	81	16	(14, 30)	23.64	(15, 18)	25.92	9.61	([illegible], 29)	25.26	6.85	-2.76	*
0	15	81	16	(19, 24)	26.96	(19, 24)	26.96	0.0	(22, 33)	31.61	17.22	17.22	
2	3	3	16	(6, 17)	9.90	(6, 16)	9.82	0.26	(7, 17)	9.99	1.93	1.67	
2	7	3	16	(16, 32)	14.88	(17, 32)	14.94	0.42	(18, 31)	15.16	1.88	1.46	
2	11	3	16	(27, 45)	18.53	(28, 46)	18.58	0.29	(29, 44)	18.79	1.39	1.10	
2	15	3	16	(38, 60)	21.51	(40, 50)	24.04	11.74	(40, 57)	21.99	2.23	-9.51	*
2	3	9	16	(8, 19)	11.93	(9, 19)	11.94	0.06	(10, 19)	12.25	2.62	2.56	
2	7	9	16	(21, 35)	18.08	(21, 36)	18.11	0.16	([illegible], 34)	18.31	1.28	1.12	
2	11	9	16	(33, 50)	22.45	(33, 51)	22.50	0.24	(34, 48)	22.74	1.30	1.06	
2	15	9	16	(45, 66)	26.10	(45, 54)	27.87	6.79	(47, 61)	27.66	5.99	-0.80	*
2	3	27	16	(11, 21)	13.80	(11, 21)	13.80	0.0	(12, 21)	14.07	2.00	2.00	
2	7	27	16	(24, 39)	20.84	(24, 39)	20.89	0.22	(26, 37)	21.39	2.65	2.43	
2	11	27	16	(37, 53)	25.86	(37, 55)	25.95	0.35	(39, 51)	26.86	3.87	3.52	
2	15	27	16	(50, 70)	30.06	(49, 57)	31.34	4.29	(52, 64)	32.52	8.18	3.90	
2	3	81	16	(13, 22)	15.50	(13, 23)	15.50	0.00	(14, 23)	15.84	2.21	2.21	
2	7	81	16	(27, 40)	23.28	(27, 42)	23.38	0.44	(29, 40)	23.99	3.03	2.59	
2	11	81	16	(40, 57)	28.85	(40, 58)	28.93	0.28	(42, 54)	29.74	3.06	2.78	
2	15	81	16	(54, 74)	33.50	(53, 60)	34.42	2.76	(56, 68)	36.17	7.98	5.22	
4	3	3	16	(12, 24)	10.55	(12, 22)	10.64	0.86	(14, 23)	11.03	4.54	3.67	
4	7	3	16	(30, 47)	16.03	(31, 46)	16.09	0.40	(33, 46)	16.50	2.94	2.55	
4	11	3	16	(49, 69)	19.99	(51, 69)	20.11	0.63	(52, 67)	20.38	1.97	1.34	
4	15	3	16	(68, 91)	23.17	(70, 81)	26.12	12.71	(71, 88)	23.75	2.51	-10.21	*
4	3	9	16	(15, 26)	13.09	(15, 25)	13.14	0.39	(17, 26)	13.51	3.24	2.85	
4	7	9	16	(36, 51)	19.88	(36, 51)	19.88	0.0	(38, 49)	20.50	3.12	3.12	
4	11	9	16	(56, 74)	24.71	(56, 74)	24.71	0.0	(58, 71)	25.37	2.71	2.71	
4	15	9	16	(76, 97)	28.69	(76, 96)	31.14	8.52	(78, 93)	29.78	3.78	-4.74	*
4	3	27	16	(18, 28)	15.39	(13, 28)	15.39	0.0	(20, 28)	16.06	4.37	4.37	
4	7	27	16	(40, 54)	23.27	(39, 54)	23.32	0.25	(42, 53)	23.86	2.57	2.32	
4	11	27	16	(61, 78)	28.89	(60, 78)	28.98	0.33	(63, 76)	29.49	2.12	1.79	
4	15	27	16	(82, 103)	33.56	(81, 91)	35.50	5.80	(84, 97)	35.38	5.44	-0.36	*
4	3	81	16	(20, 30)	17.46	(21, 31)	17.54	0.45	(22, 30)	17.99	3.05	2.60	
4	7	81	16	(43, 57)	26.26	(43, 58)	26.28	0.09	(45, 56)	26.72	1.75	1.66	
4	11	81	16	(65, 82)	32.57	(65, 83)	32.61	0.12	(67, 79)	33.46	2.74	2.62	
4	15	81	16	(87, 108)	37.82	(87, 94)	39.58	4.63	(89, 102)	39.76	5.12	0.49	

AVERAGE % ERROR IN TOTAL EXP.COST — 2.17 — 4.05

AVERAGE EXP.COST FOR EACH CASE — 18.54 — 18.96 — 19.26
TOTAL EXP.COST FOR EACH CASE — 1779.46 — 1820.34 — 1849.33

AVERAGE % ERROR DIFFERENCE NAI-POW — 1.88

COMPARISON OF OPT. POWER & NADDOR APPROXIMATIONS

VARIANCE-TO-MEAN RATIO = 1

******* O R I G I N A L   O R D E R *******

IN THIS TABLE SET-UP COSTS ARE: 32 AND 64

EXP.COST IS EXP. TOTAL COST

L	M	PI	K	OPTIMAL POLICY (S,S)	OPTIMAL POLICY EXP.COST	POWER APPROXIMATION (S,S)	POWER APPROXIMATION EXP.COST	POWER APPROXIMATION ERROR	NADDOR APPROXIMATION (S,S)	NADDOR APPROXIMATION EXP.COST	NADDOR APPROXIMATION ERROR	COMPARISON NAD-POW	COMPARISON ND<PW
0	3	3	32	(-2, 13)	12.29	(0, 13)	12.53	2.01	(0, 14)	12.53	1.99	-0.02	•
0	7	3	32	(0, 22)	18.73	(1, 20)	18.83	0.52	(1, 22)	18.76	0.16	-0.36	•
0	11	3	32	(3, 29)	23.45	(4, 27)	23.57	0.51	(3, 28)	23.45	0.00	-0.51	•
0	15	3	32	(5, 32)	27.20	(7, 34)	27.36	0.61	(6, 33)	27.22	0.08	-0.54	•
0	3	9	32	(1, 15)	13.95	(1, 14)	13.98	0.22	(3, 16)	14.66	5.06	4.84	
0	7	9	32	(4, 24)	21.32	(5, 24)	21.33	0.08	(6, 24)	21.63	1.48	1.40	
0	11	9	32	(6, 32)	26.70	(8, 31)	26.71	0.04	(9, 31)	26.85	0.56	0.52	
0	15	9	32	(12, 35)	30.67	(12, 39)	31.14	1.51	(13, 37)	30.97	0.98	-0.53	•
0	3	27	32	(3, 16)	15.31	(3, 16)	15.31	0.0	(5, 18)	16.44	7.33	7.33	
0	7	27	32	(7, 26)	23.29	(7, 26)	23.29	0.0	(9, 27)	24.00	3.07	3.07	
0	11	27	32	(11, 35)	29.20	(11, 34)	29.20	0.02	(14, 35)	30.40	4.12	4.11	
0	15	27	32	(15, 38)	33.40	(16, 43)	34.26	2.56	(18, 41)	34.52	3.35	0.79	
0	3	81	32	(4, 17)	16.48	(5, 18)	16.72	1.45	(7, 20)	18.33	11.25	9.81	
0	7	81	32	(9, 28)	24.96	(9, 29)	24.96	0.0	(12, 30)	26.63	6.69	6.69	
0	11	81	32	(14, 37)	31.31	(14, 37)	31.31	0.0	([illegible], 38)	34.04	8.72	8.72	
0	15	81	32	(18, 40)	35.68	(18, 45)	36.51	2.32	(22, 44)	37.81	5.95	3.63	
2	3	3	32	(4, 20)	12.98	(5, 19)	13.05	0.56	(6, 20)	13.22	1.90	1.34	
2	7	3	32	(14, 37)	19.79	(15, 36)	19.84	0.29	(15, 36)	19.84	0.29	0.0	
2	11	3	32	(24, 52)	24.76	(26, 51)	24.87	0.44	(26, 50)	24.93	0.66	0.22	
2	15	3	32	(35, 65)	28.89	(37, 66)	29.04	0.51	(36, 64)	28.93	0.14	-0.37	•
2	3	9	32	(8, 22)	15.33	(8, 22)	15.33	0.0	(9, 23)	15.57	1.53	1.53	
2	7	9	32	(19, 40)	23.34	(19, 40)	23.34	0.0	(21, 40)	23.60	1.13	1.13	
2	11	9	32	(31, 57)	29.19	(31, 56)	29.19	0.01	(33, 55)	29.56	1.25	1.24	
2	15	9	32	(43, 69)	33.89	(43, 72)	34.10	0.61	(44, 69)	33.99	0.29	-0.32	•
2	3	27	32	(10, 24)	17.33	(10, 24)	17.33	0.0	(12, 25)	17.91	3.39	3.39	
2	7	27	32	(23, 43)	26.30	(23, 44)	26.30	0.03	(25, 43)	26.79	1.86	1.83	
2	11	27	32	(36, 60)	32.90	(35, 60)	32.96	0.16	(38, 59)	33.52	1.86	1.70	
2	15	27	32	(48, 72)	38.01	(48, 77)	38.45	1.15	(51, 73)	38.53	1.35	0.20	
2	3	81	32	(12, 26)	19.07	(12, 26)	19.07	0.0	(14, 27)	19.75	3.51	3.51	
2	7	81	32	(26, 46)	28.85	(26, 47)	28.88	0.09	(29, 46)	30.09	4.29	4.20	
2	11	81	32	(39, 64)	36.08	(39, 64)	36.08	0.0	(42, 63)	36.94	2.39	2.39	
2	15	81	32	(53, 76)	41.56	(52, 81)	42.18	1.49	(56, 78)	42.63	2.58	1.09	
4	3	3	32	(10, 27)	13.61	(11, 26)	13.65	0.31	(12, 26)	13.84	1.68	1.37	
4	7	3	32	(28, 52)	20.74	(29, 50)	20.84	0.48	(30, 51)	20.92	0.89	0.40	
4	11	3	32	(47, 75)	25.94	(48, 74)	26.04	0.36	(48, 73)	26.10	0.59	0.23	
4	15	3	32	(65, 98)	30.28	(67, 97)	30.41	0.41	(67, 95)	30.47	0.60	0.20	
4	3	9	32	(14, 29)	16.39	(14, 29)	16.39	0.0	(16, 29)	16.77	2.26	2.26	
4	7	9	32	(34, 56)	24.93	(34, 55)	24.95	0.07	(36, 55)	25.23	1.20	1.13	
4	11	9	32	(54, 81)	31.18	(54, 80)	31.18	0.00	(56, 78)	31.56	1.20	1.20	
4	15	9	32	(74, 101)	36.34	(74, 104)	36.42	0.21	(76, 100)	36.54	0.54	0.33	
4	3	27	32	(17, 32)	18.82	(17, 32)	18.82	0.0	(19, 32)	19.28	2.46	2.46	
4	7	27	32	(39, 60)	28.55	(38, 59)	28.59	0.14	(41, 59)	29.13	2.02	1.87	
4	11	27	32	(60, 85)	35.68	(59, 85)	35.72	0.11	(62, 83)	36.25	1.60	1.49	
4	15	27	32	(81, 105)	41.42	(80, 110)	41.70	0.67	(83, 106)	41.75	0.81	0.13	
4	3	81	32	(20, 34)	20.95	(20, 35)	20.99	0.16	(22, 34)	21.85	4.26	4.10	
4	7	81	32	(42, 63)	31.68	(42, 63)	31.68	0.0	(45, 62)	32.59	2.88	2.88	
4	11	81	32	(64, 89)	39.55	(64, 90)	39.56	0.03	(67, 87)	40.45	2.28	2.26	
4	15	81	32	(86, 110)	45.77	(85, 115)	46.27	1.09	(89, 111)	46.47	1.53	0.44	
0	3	3	64	(-3, 18)	17.17	(-1, 18)	17.52	2.08	(-2, 18)	17.27	0.59	-1.50	•

0	7	3	64	(-2, 29)	26.21	(0, 27)	26.53	1.23	(-1, 29)	26.27	0.25	-0.98	•
0	11	3	64	(0, 39)	32.82	(2, 35)	33.15	1.00	(0, 37)	32.82	0.02	-0.98	•
0	15	3	64	(2, 45)	38.25	(5, 42)	38.71	1.19	(1, 43)	38.32	0.18	-1.01	•
0	3	9	64	(0, 20)	19.22	(0, 19)	19.26	0.18	(2, 21)	19.65	2.22	2.03	
0	7	9	64	(3, 32)	29.33	(4, 31)	29.39	0.22	(4, 32)	29.36	0.12	-0.10	•
0	11	9	64	(7, 42)	36.74	(7, 40)	36.76	0.07	(7, 41)	36.74	0.01	-0.07	•
0	15	9	64	(10, 49)	42.70	(11, 48)	42.81	0.27	(11, 49)	42.78	0.20	-0.08	•
0	3	27	64	(4, 22)	20.69	(3, 22)	20.78	0.44	(5, 24)	22.16	7.11	6.67	
0	7	27	64	(6, 35)	31.53	(7, 34)	31.60	0.24	(9, 37)	32.70	3.72	3.48	
0	11	27	64	(10, 44)	39.46	(10, 43)	39.47	0.04	(14, 46)	41.20	4.40	4.37	
0	15	27	64	(14, 52)	45.63	(14, 51)	45.67	0.09	(18, 54)	47.32	3.27	3.18	
0	3	81	64	(4, 23)	21.90	(4, 23)	21.90	0.0	(8, 27)	25.07	14.47	14.47	
0	7	81	64	(6, 36)	33.34	(9, 36)	33.37	0.09	(13, 40)	36.36	9.06	8.96	
0	11	81	64	(13, 46)	41.64	(13, 46)	41.64	0.0	(19, 51)	45.88	10.19	10.19	
0	15	81	64	(17, 55)	48.33	(17, 54)	48.35	0.04	(24, 60)	52.81	9.27	9.23	
2	3	3	64	(3, 25)	17.69	(3, 23)	17.75	0.36	(4, 25)	17.80	0.65	0.28	
2	7	3	64	(12, 44)	27.00	(13, 42)	27.15	0.55	(12, 43)	27.01	0.05	-0.49	•
2	11	3	64	(21, 61)	33.80	(23, 58)	34.00	0.60	(22, 59)	33.85	0.16	-0.44	•
2	15	3	64	(31, 76)	39.43	(34, 74)	39.66	0.59	(32, 74)	39.48	0.12	-0.47	•
2	3	9	64	(7, 27)	20.35	(7, 27)	20.35	0.0	(8, 28)	20.54	0.96	0.96	
2	7	9	64	(18, 48)	31.03	(18, 47)	31.04	0.05	(19, 47)	31.15	0.40	0.35	
2	11	9	64	(29, 66)	38.85	(29, 64)	38.89	0.10	(31, 64)	39.11	0.65	0.55	
2	15	9	64	(41, 82)	45.25	(41, 81)	45.26	0.00	(42, 80)	45.37	0.26	0.26	
2	3	27	64	(10, 30)	22.54	(9, 29)	22.55	0.03	(12, 31)	23.50	4.27	4.24	
2	7	27	64	(22, 51)	34.23	(22, 51)	34.23	0.0	(25, 52)	35.23	2.91	2.91	
2	11	27	64	(34, 70)	42.85	(34, 69)	42.86	0.02	(37, 70)	43.47	1.45	1.43	
2	15	27	64	(47, 86)	49.82	(46, 86)	49.88	0.11	(50, 86)	50.64	1.64	1.53	
2	3	81	64	(12, 33)	24.35	(12, 32)	24.36	0.03	(15, 34)	26.21	7.64	7.61	
2	7	81	64	(25, 54)	36.93	(25, 54)	36.93	0.0	(29, 56)	38.71	4.84	4.84	
2	11	81	64	(38, 73)	46.17	(38, 73)	46.17	0.0	(43, 75)	48.34	4.70	4.70	
2	15	81	64	(51, 90)	53.64	(51, 91)	53.66	0.04	(56, 92)	55.54	3.53	3.50	
4	3	3	64	(9, 31)	18.18	(9, 30)	18.21	0.17	(10, 31)	18.30	0.64	0.48	
4	7	3	64	(25, 59)	27.74	(27, 57)	27.88	0.50	(27, 57)	27.88	0.50	0.0	
4	11	3	64	(43, 84)	34.73	(45, 82)	34.98	0.42	(44, 82)	34.79	0.16	-0.25	•
4	15	3	64	(61, 107)	40.52	(64, 106)	40.74	0.54	(62, 105)	40.58	0.15	-0.39	•
4	3	9	64	(13, 34)	21.28	(13, 34)	21.28	0.0	(15, 34)	21.64	1.71	1.71	
4	7	9	64	(33, 63)	32.45	(32, 62)	32.49	0.11	(34, 62)	32.63	0.55	0.44	
4	11	9	64	(52, 90)	40.60	(52, 89)	40.60	0.01	(54, 87)	40.92	0.80	0.79	
4	15	9	64	(72, 114)	47.33	(72, 114)	47.33	0.0	(73, 111)	47.49	0.35	0.35	
4	3	27	64	(16, 37)	23.89	(16, 37)	23.89	0.0	(19, 37)	24.77	3.69	3.69	
4	7	27	64	(37, 67)	36.32	(37, 67)	36.32	0.0	(40, 67)	36.94	1.72	1.72	
4	11	27	64	(56, 94)	45.41	(57, 94)	45.54	0.30	(61, 93)	46.08	1.49	1.19	
4	15	27	64	(79, 119)	52.85	(78, 120)	52.92	0.13	(82, 118)	53.55	1.31	1.19	
4	3	81	64	(19, 39)	26.08	(19, 40)	26.10	0.07	(22, 41)	27.43	5.20	5.13	
4	7	81	64	(41, 71)	39.59	(41, 71)	39.59	0.0	(45, 72)	41.05	3.69	3.69	
4	11	81	64	(63, 98)	49.46	(62, 99)	49.58	0.25	(67, 99)	50.94	2.99	2.74	
4	15	81	64	(84, 124)	57.53	(83, 125)	57.74	0.36	(89, 124)	59.15	2.81	2.45	

AVERAGE % ERROR IN TOTAL EXP.COST			0.35		2.53	
AVERAGE EXP.COST PER EACH CASE	30.80	30.91		31.56		
TOTAL EXP.COST FOR EACH CASE	2957.09	2967.16		3030.05		
AVERAGE % ERROR DIFFERENCE NAE-ECW						2.18
SUMMARY-AVERAGE EXP.COST PER EACH CASE	24.67	24.93		25.41		
SUMMARY-TOTAL EXP.COST PER EACH CASE	4736.55	4787.50		4879.38		
TOTAL AVERAGE % ERROR IN TOTAL EXP.COST			1.26		3.29	
TOTAL AVERAGE % ERROR DIFFERENCE NAE-ECW						2.03

COMPARISON OF OPT. POWER & NADDOR APPROXIMATIONS

VARIANCE-TO-MEAN RATIO = 3

******* O R I G I N A L   O R D E R *******

IN THIS TABLE SET-UP COSTS ARE: 8 AND 16

EXP.COST IS EXP. TOTAL COST

L	R	PI	K	OPTIMAL POLICY (S,S)	OPTIMAL POLICY EXP.COST	POWER APPROXIMATION (S,S)	POWER EXP.COST	POWER ERROR	NADDOR APPROXIMATION (S,S)	NADDOR EXP.COST	NADDOR ERROR	COMPARISON NAD-POW	COMPARISON ND<PW
0	3	3	8	(0, 8)	7.52	(1, 8)	7.59	1.04	(3, 9)	8.33	10.87	9.82	
0	7	3	8	(3, 13)	11.47	(4, 10)	12.08	5.35	(6, 14)	11.97	4.38	-0.97	*
0	11	3	8	(7, 18)	14.25	(7, 15)	14.55	2.14	(9, 18)	14.56	2.16	0.02	
0	15	3	8	(10, 21)	16.37	(11, 20)	16.45	0.48	(13, 22)	16.71	2.09	1.61	
0	3	9	8	(3, 10)	10.11	(4, 11)	10.27	1.63	(5, 11)	10.59	4.77	3.14	
0	7	9	8	(7, 17)	15.03	(8, 13)	15.89	5.75	(10, 17)	15.55	3.45	-2.30	*
0	11	9	8	(12, 22)	18.46	(12, 18)	19.11	3.51	(14, 21)	18.80	1.87	-1.65	*
0	15	9	8	(16, 25)	21.01	(17, 24)	21.11	0.50	(16, 25)	21.12	0.54	0.04	
0	3	27	8	(6, 13)	12.93	(6, 13)	12.93	0.0	(7, 13)	13.09	1.24	1.24	
0	7	27	8	(11, 21)	18.66	(12, 15)	20.85	11.75	(13, 20)	18.89	1.24	-10.52	*
0	11	27	8	(17, 26)	22.65	(17, 21)	24.03	6.07	(18, 24)	22.92	1.17	-4.90	*
0	15	27	8	(24, 30)	25.55	(22, 27)	26.19	2.48	(23, 28)	25.62	1.06	-1.42	*
0	3	81	8	(9, 16)	15.81	(9, 16)	15.81	0.0	(9, 15)	15.85	0.25	0.25	
0	7	81	8	(15, 24)	22.19	(16, 17)	27.02	21.76	(15, 22)	22.38	0.87	-20.88	*
0	11	81	8	(21, 30)	26.67	(22, 24)	29.32	9.91	([illegible], 27)	27.00	1.23	-8.68	*
0	15	81	8	(27, 34)	29.91	(27, 30)	31.92	6.75	(26, 31)	30.92	3.38	-3.36	*
2	3	3	8	(7, 16)	10.05	(8, 16)	10.15	0.98	(10, 16)	10.69	6.42	5.44	
2	7	3	8	(18, 31)	15.20	(20, 31)	15.34	0.97	(22, 30)	15.88	4.48	3.50	
2	11	3	8	(30, 44)	18.91	(32, 40)	19.69	4.09	(34, 43)	19.64	3.83	-0.26	*
2	15	3	8	(41, 57)	21.95	(44, 53)	22.55	2.77	(46, 55)	22.68	3.34	0.57	
2	3	9	8	(11, 20)	13.83	(12, 20)	13.88	0.39	(14, 19)	14.48	4.70	4.32	
2	7	9	8	(25, 36)	20.47	(26, 37)	20.57	0.51	(27, 35)	20.83	1.75	1.24	
2	11	9	8	(38, 51)	25.26	(39, 46)	26.09	3.25	(41, 48)	26.01	2.97	-0.27	*
2	15	9	8	(51, 64)	29.15	(52, 60)	29.63	1.64	(54, 61)	29.71	1.90	0.26	
2	3	27	8	(15, 23)	17.69	(16, 24)	17.72	0.12	(17, 22)	18.06	2.05	1.93	
2	7	27	8	(31, 41)	25.65	(31, 42)	25.65	0.01	(32, 39)	26.01	1.43	1.41	
2	11	27	8	(45, 57)	31.38	(46, 51)	32.79	4.49	(47, 53)	32.15	2.44	-2.04	*
2	15	27	8	(59, 71)	36.02	(59, 66)	36.74	1.98	(61, 67)	36.54	1.45	-0.53	*
2	3	81	8	(19, 27)	21.46	(21, 29)	21.76	1.43	(19, 25)	21.74	1.30	-0.13	*
2	7	81	8	(36, 46)	30.54	(36, 44)	30.98	1.45	(36, 43)	31.00	1.51	0.06	
2	11	81	8	(51, 63)	37.14	(54, 55)	40.22	8.29	(51, 58)	37.87	1.99	-6.30	*
2	15	81	8	(66, 77)	42.40	(69, 71)	44.18	4.20	(66, 72)	43.42	2.39	-1.81	*
4	3	3	8	(13, 23)	11.82	(15, 23)	11.98	1.28	(17, 23)	12.52	5.90	4.62	
4	7	3	8	(33, 47)	17.88	(35, 47)	18.02	0.78	(37, 46)	18.47	3.33	2.56	
4	11	3	8	(53, 69)	22.26	(56, 64)	23.31	4.70	(57, 67)	22.92	2.95	-1.75	*
4	15	3	8	(73, 91)	25.87	(76, 85)	26.82	3.66	(78, 87)	26.88	3.90	0.24	
4	3	9	8	(19, 28)	16.37	(20, 28)	16.47	0.56	(21, 27)	16.74	2.21	1.65	
4	7	9	8	(41, 54)	24.29	(42, 54)	24.33	0.16	(44, 51)	24.99	2.88	2.71	
4	11	9	8	(63, 77)	30.03	(64, 71)	31.24	4.02	(66, 74)	30.78	2.48	-1.55	*
4	15	9	8	(84, 100)	34.75	(85, 94)	35.46	2.04	(88, 96)	35.48	2.11	0.07	
4		27	8	(24, 32)	20.92	(25, 33)	21.01	0.44	(25, 31)	21.13	0.99	0.55	
4	7	27	8	(46, 60)	30.50	(49, 61)	30.55	0.16	(50, 57)	31.03	1.75	1.59	
4	11	27	8	([illegible], 85)	37.47	(72, 78)	39.00	4.10	(73, 81)	38.00	1.43	-2.67	*
4	15	27	8	(94, 108)	43.17	(95, 102)	44.11	2.18	(96, 103)	43.87	1.63	-0.55	*
4	3	81	8	(29, 37)	25.29	(31, 39)	25.82	2.11	(28, 34)	25.74	1.78	-0.33	*
4	7	81	8	(55, 66)	36.32	(58, 70)	37.25	2.54	(55, 62)	36.93	1.66	-0.87	*
4	11	81	8	(79, 92)	44.36	(83, 94)	47.11	6.20	(80, 86)	45.53	2.63	-3.56	*
4	15	81	8	(103, 116)	50.94	(107, 109)	52.53	3.13	(103, 110)	51.85	1.80	-1.33	*
0	3	3	16	(-1, 10)	9.62	(0, 10)	9.67	0.52	(1, 11)	9.97	3.62	3.10	

0	7	3	16	(2, 17)	14.73	(2, 17)	14.73	0.0	(4, 18)	15.08	2.34	2.34	
0	11	3	16	(5, 22)	18.42	(5, 23)	18.42	0.02	(7, 23)	18.69	1.46	1.44	
0	15	3	16	(8, 27)	21.44	(8, 20)	22.60	5.33	(10, 27)	21.67	1.05	-4.34	*
0	3	9	16	(2, 12)	12.26	(3, 13)	12.36	0.83	(4, 14)	12.73	3.81	2.98	
0	7	9	16	(6, 20)	18.45	(7, 22)	18.54	0.49	(8, 21)	18.65	1.32	0.82	
0	11	9	16	(10, 27)	22.91	(11, 29)	23.01	0.45	(12, 27)	23.09	0.80	0.35	
0	15	9	16	(14, 33)	26.60	(15, 24)	28.06	5.47	(17, 31)	27.12	1.53	-3.54	*
0	3	27	16	(5, 15)	15.09	(5, 15)	15.09	0.0	(6, 16)	15.22	0.86	0.86	
0	7	27	16	(10, 24)	22.16	(11, 26)	22.27	0.48	(12, 24)	22.40	1.10	0.62	
0	11	27	16	(15, 31)	27.26	(15, 33)	27.32	0.21	(17, 30)	27.56	1.09	0.88	
0	15	27	16	(20, 38)	31.49	(20, 27)	33.71	7.03	(22, 35)	31.94	1.43	-5.60	*
0	3	81	16	(8, 18)	17.98	(8, 19)	17.98	0.0	(8, 19)	18.02	0.21	0.21	
0	7	81	16	(14, 28)	25.76	(14, 29)	25.79	0.15	(15, 27)	25.83	0.30	0.15	
0	11	81	16	(20, 35)	31.40	(20, 38)	31.53	0.41	(20, 34)	31.44	0.13	-0.28	*
0	15	81	16	(25, 42)	36.10	(25, 30)	39.73	10.08	(26, 39)	36.32	0.63	-9.45	*
2	3	3	16	(5, 18)	11.98	(6, 17)	11.90	0.14	(8, 18)	12.25	3.10	2.95	
2	7	3	16	(16, 34)	18.04	(17, 33)	18.08	0.22	(20, 33)	18.66	3.44	3.22	
2	11	3	16	(27, 48)	22.50	(29, 48)	22.59	0.40	(31, 47)	23.00	2.21	1.81	
2	15	3	16	(39, 62)	26.17	(40, 53)	28.01	7.03	(43, 60)	26.85	2.62	-4.41	*
2	3	9	16	(10, 22)	15.75	(10, 21)	15.76	0.04	(13, 22)	16.35	3.83	3.79	
2	7	9	16	(23, 39)	23.51	(23, 39)	23.51	0.0	(26, 36)	24.04	2.24	2.24	
2	11	9	16	(36, 55)	29.13	(36, 55)	29.13	0.0	(39, 53)	29.71	1.98	1.98	
2	15	9	16	(49, 70)	33.76	(49, 60)	35.93	6.39	(52, 66)	34.67	2.64	-3.74	*
2	3	27	16	(14, 26)	19.68	(15, 25)	19.69	0.02	(16, 25)	19.88	1.02	1.00	
2	7	27	16	(29, 45)	28.81	(29, 45)	28.81	0.0	(31, 43)	29.11	1.03	1.03	
2	11	27	16	(43, 61)	35.46	(43, 62)	35.46	0.01	(45, 58)	35.93	1.32	1.32	
2	15	27	16	(57, 77)	40.95	(57, 66)	43.75	6.84	(59, 73)	41.52	1.41	-5.43	*
2	3	81	16	(19, 29)	23.49	(19, 30)	23.49	0.03	(18, 28)	23.57	0.35	0.31	
2	7	81	16	(35, 50)	33.90	(36, 52)	34.02	0.64	(35, 47)	34.02	0.65	0.01	
2	11	81	16	(50, 67)	41.33	(51, 70)	41.54	0.50	(50, 63)	41.79	1.10	0.60	
2	15	81	16	(64, 84)	47.58	(65, 71)	51.74	8.73	(65, 78)	48.21	1.32	-7.41	*
4	3	3	16	(14, 25)	13.53	(13, 24)	13.63	0.74	(15, 25)	14.00	3.48	2.75	
4	7	3	16	(31, 50)	20.53	(32, 48)	20.66	0.63	(35, 49)	21.13	2.94	2.31	
4	11	3	16	(50, 73)	25.61	(52, 72)	25.72	0.44	(55, 71)	26.36	2.94	2.50	
4	15	3	16	(69, 95)	29.79	(72, 95)	29.92	0.44	(75, 92)	30.74	3.21	2.77	
4	3	9	16	(18, 30)	18.20	(18, 29)	18.22	0.13	(20, 29)	18.60	2.21	2.08	
4	7	9	16	(39, 57)	27.15	(40, 56)	27.18	0.10	(42, 55)	27.57	1.55	1.44	
4	11	9	16	(61, 81)	33.66	(61, 81)	33.66	0.0	(64, 78)	34.39	2.16	2.16	
4	15	9	16	(82, 105)	39.03	(82, 105)	39.03	0.0	(85, 100)	39.93	2.31	2.31	
4	3	27	16	(23, 35)	22.81	(23, 34)	22.81	0.02	(24, 33)	23.01	0.89	0.87	
4	7	27	16	(47, 63)	33.49	(47, 63)	33.49	0.0	(48, 60)	33.89	1.18	1.18	
4	11	27	16	(70, 89)	41.29	(69, 89)	41.30	0.04	(72, 85)	41.99	1.71	1.67	
4	15	27	16	(92, 114)	47.72	(92, 115)	47.74	0.05	(94, 108)	48.58	1.80	1.75	
4	3	81	16	(28, 39)	27.22	(29, 40)	27.39	0.61	(27, 37)	27.40	0.66	0.05	
4	7	81	16	(53, 65)	39.43	(55, 71)	39.64	0.53	(54, 65)	40.00	1.45	0.92	
4	11	81	16	(76, 96)	48.33	(79, 99)	48.56	0.47	(78, 91)	49.00	1.37	0.91	
4	15	81	16	(101, 122)	55.69	(103, 126)	56.12	0.76	(102, 115)	56.67	1.76	1.00	
AVERAGE % ERROR IN TOTAL EXP.COST								2.30			2.17		
AVERAGE EXP.COST FOR EACH CASE					25.88		26.53			26.38			
TOTAL EXP.COST FOR EACH CASE					2484.92		2547.33			2532.66			
AVERAGE % ERROR DIFFERENCE												-0.14	

COMPARISON OF OPT. POWER & NADDOR APPROXIMATIONS

VARIANCE-TO-MEAN RATIO = 3

******* O R I G I N A L   O R D E R S *******

IN THIS TABLE SET-UP COSTS ARE: 32 AND 64

EXP.COST IS EXP. TOTAL COST

L	M	PI	K	OPTIMAL POLICY (S,S)	OPTIMAL POLICY EXP.COST	POWER APPROXIMATION (S,S)	POWER APPROXIMATION EXP.COST	POWER APPROXIMATION ERROR	NADDOR APPROXIMATION (S,S)	NADDOR APPROXIMATION EXP.COST	NADDOR APPROXIMATION ERROR	COMPARISON NAD-POW	COMPARISON ND<PW
0	3	3	32	(-2, 13)	12.82	(-1, 13)	12.87	0.39	(0, 15)	13.22	3.12	2.73	
0	7	3	32	(0, 22)	19.63	(0, 21)	19.64	0.03	(1, 23)	19.72	0.46	0.44	
0	11	3	32	(2, 29)	24.59	(2, 27)	24.63	0.15	(4, 29)	24.70	0.46	0.31	
0	15	3	32	(5, 35)	28.65	(5, 34)	28.65	0.02	(6, 35)	28.68	0.12	0.10	
0	3	9	32	(1, 16)	15.54	(1, 15)	15.55	0.02	(3, 18)	16.00	2.94	2.92	
0	7	9	32	(5, 26)	23.56	(5, 26)	23.56	0.0	(7, 27)	23.92	1.52	1.52	
0	11	9	32	(9, 33)	29.39	(9, 34)	29.40	0.01	(11, 34)	29.73	1.16	1.15	
0	15	9	32	(13, 40)	34.18	(13, 42)	34.23	0.13	(14, 40)	34.30	0.33	0.21	
0	3	27	32	(4, 16)	18.41	(5, 19)	18.46	0.30	(6, 21)	18.90	2.68	2.38	
0	7	27	32	(9, 29)	27.38	(9, 30)	27.38	0.02	(11, 31)	27.70	1.18	1.16	
0	11	27	32	(14, 38)	33.89	(14, 39)	33.91	0.06	(16, 38)	34.24	1.05	0.99	
0	15	27	32	(19, 45)	39.27	(19, 49)	39.37	0.25	(21, 45)	39.72	1.14	0.88	
0	3	81	32	(7, 21)	21.31	(7, 21)	21.31	0.0	(8, 23)	21.45	0.63	0.63	
0	7	81	32	(13, 33)	31.04	(13, 34)	31.05	0.06	(15, 34)	31.39	1.16	1.10	
0	11	81	32	(19, 42)	38.14	(19, 44)	38.19	0.14	(2[illegible], 43)	38.33	0.50	0.35	
0	15	81	32	(24, 50)	43.96	(24, 53)	44.09	0.28	(26, 49)	44.44	1.07	0.79	
2	3	3	32	(4, 21)	14.70	(4, 19)	14.77	0.46	(7, 22)	15.23	3.60	3.13	
2	7	3	32	(14, 38)	22.42	(14, 36)	22.52	0.45	(17, 38)	22.78	1.61	1.16	
2	11	3	32	(24, 54)	28.03	(25, 52)	28.09	0.22	(28, 53)	28.44	1.45	1.23	
2	15	3	32	(35, 69)	32.65	(36, 67)	32.69	0.14	(39, 67)	33.07	1.29	1.15	
2	3	9	32	(9, 25)	18.73	(9, 24)	18.74	0.05	(11, 25)	19.04	1.67	1.62	
2	7	9	32	(21, 44)	28.18	(21, 43)	28.21	0.09	(24, 43)	28.57	1.39	1.30	
2	11	9	32	(34, 61)	35.05	(34, 61)	35.05	0.0	(36, 59)	35.36	0.87	0.87	
2	15	9	32	(46, 77)	40.72	(46, 77)	40.72	0.0	(49, 74)	41.19	1.15	1.15	
2	3	27	32	(13, 29)	22.74	(13, 28)	22.75	0.05	(15, 29)	22.94	0.87	0.82	
2	7	27	32	(28, 50)	33.64	(27, 49)	33.69	0.15	(29, 48)	33.80	0.46	0.31	
2	11	27	32	(42, 68)	41.61	(41, 68)	41.62	0.01	(43, 65)	41.85	0.57	0.57	
2	15	27	32	(55, 84)	48.17	(54, 85)	48.23	0.12	(57, 81)	48.55	0.80	0.68	
2	3	81	32	(18, 33)	26.60	(17, 32)	26.62	0.09	(18, 32)	26.60	0.02	-0.08	*
2	7	81	32	(33, 55)	38.75	(33, 55)	38.75	0.0	(34, 53)	38.83	0.19	0.19	
2	11	81	32	(48, 74)	47.63	(48, 75)	47.66	0.05	(49, 71)	47.79	0.32	0.27	
2	15	81	32	(63, 91)	54.97	(62, 93)	55.04	0.12	(63, 97)	55.22	0.46	0.33	
4	3	3	32	(10, 28)	16.20	(10, 26)	16.30	0.60	(13, 28)	16.55	2.17	1.56	
4	7	3	32	(28, 54)	24.65	(29, 52)	24.76	0.45	(32, 53)	25.12	1.91	1.46	
4	11	3	32	(47, 79)	30.80	(48, 76)	30.92	0.39	(51, 76)	31.34	1.75	1.36	
4	15	3	32	(66, 102)	35.87	(67, 99)	35.99	0.32	(70, 98)	36.46	1.63	1.31	
4	3	9	32	(16, 33)	21.02	(16, 32)	21.04	0.09	(19, 33)	21.48	2.15	2.06	
4	7	9	32	(37, 61)	31.58	(37, 60)	31.61	0.11	(40, 60)	31.93	1.11	1.00	
4	11	9	32	(58, 87)	39.26	(58, 86)	39.28	0.05	(61, 84)	39.74	1.22	1.17	
4	15	9	32	(79, 112)	45.61	(78, 110)	45.66	0.11	(82, 107)	46.25	1.40	1.29	
4	3	27	32	(22, 38)	25.74	(21, 37)	25.78	0.14	(23, 37)	25.88	0.55	0.41	
4	7	27	32	(45, 68)	38.10	(44, 67)	38.20	0.24	(47, 66)	38.41	0.60	0.56	
4	11	27	32	(68, 95)	47.15	(67, 95)	47.16	0.02	(70, 91)	47.75	1.27	1.24	
4	15	27	32	(90, 121)	54.61	(88, 120)	54.74	0.23	(92, 116)	55.17	1.02	0.79	
4	3	81	32	(27, 42)	30.23	(27, 43)	30.24	0.06	(27, 41)	30.26	0.13	0.07	
4	7	81	32	(52, 74)	44.16	(52, 75)	44.17	0.03	(52, 71)	44.36	0.46	0.43	
4	11	81	32	(76, 102)	54.37	(76, 104)	54.40	0.07	(76, 98)	54.69	0.60	0.53	
4	15	81	32	(99, 129)	62.79	(99, 131)	62.85	0.10	(100, 123)	63.38	0.94	0.84	
0	3	3	64	(-3, 18)	17.57	(-3, 17)	17.57	0.02	(-1, 19)	17.97	2.29	2.28	

0	7	3	64	(-2, 29)	26.87	(-2, 27)	26.52	0.19	(-1, 30)	26.96	0.37	0.17	
0	11	3	64	(-1, 38)	33.65	(0, 35)	33.75	0.29	(0, 38)	33.67	0.04	-0.25	*
0	15	3	64	(1, 45)	39.27	(2, 42)	39.38	0.29	(2, 45)	39.27	0.01	-0.28	*
0	3	9	64	(0, 20)	20.44	(0, 20)	20.44	0.0	(2, 23)	20.84	1.95	1.95	
0	7	9	64	(4, 33)	31.15	(3, 32)	31.19	0.12	(5, 35)	31.34	0.63	0.50	
0	11	9	64	(7, 43)	38.95	(7, 42)	38.96	0.03	(9, 44)	39.23	0.72	0.69	
0	15	9	64	(10, 51)	45.41	(10, 50)	45.43	0.04	(12, 51)	45.54	0.27	0.23	
0	3	27	64	(3, 23)	23.35	(4, 24)	23.37	0.06	(6, 27)	24.29	4.01	3.55	
0	7	27	64	(8, 37)	35.08	(8, 37)	35.08	0.0	(11, 40)	35.95	2.48	2.48	
0	11	27	64	(13, 48)	43.67	(12, 47)	43.68	0.02	(15, 50)	44.21	1.22	1.20	
0	15	27	64	(17, 57)	50.74	(17, 57)	50.74	0.0	(20, 58)	51.45	1.41	1.41	
0	3	81	64	(6, 26)	26.28	(6, 26)	26.28	0.0	(9, 30)	27.24	3.66	3.66	
0	7	81	64	(12, 41)	38.81	(12, 41)	38.81	0.0	(15, 44)	39.75	2.43	2.43	
0	11	81	64	(17, 52)	48.00	(17, 52)	48.00	0.0	(21, 55)	49.24	2.57	2.57	
0	15	81	64	(22, 62)	55.59	(22, 62)	55.59	0.0	(26, 64)	56.72	2.03	2.03	
2	3	3	64	(2, 25)	19.03	(1, 23)	19.19	0.88	(4, 26)	19.20	0.91	0.02	
2	7	3	64	(11, 45)	29.06	(11, 42)	29.19	0.45	(13, 45)	29.18	0.40	-0.05	*
2	11	3	64	(21, 62)	36.39	(21, 59)	36.52	0.35	(23, 61)	36.54	0.40	0.05	
2	15	3	64	(31, 78)	42.45	(32, 76)	42.52	0.18	(33, 76)	42.60	0.36	0.17	
2	3	9	64	(8, 29)	23.27	(7, 29)	23.30	0.13	(10, 30)	23.68	1.76	1.62	
2	7	9	64	(19, 51)	35.24	(19, 50)	35.26	0.06	(22, 51)	35.57	0.94	0.88	
2	11	9	64	(31, 70)	43.97	(31, 69)	43.98	0.02	(34, 69)	44.30	0.75	0.72	
2	15	9	64	(43, 87)	51.19	(43, 87)	51.19	0.0	(46, 85)	51.55	0.71	0.71	
2	3	27	64	(12, 33)	27.37	(12, 34)	27.38	0.02	(14, 35)	27.67	1.07	1.05	
2	7	27	64	(26, 57)	40.91	(25, 56)	41.02	0.29	(28, 57)	41.13	0.55	0.27	
2	11	27	64	(40, 77)	50.82	(39, 77)	50.83	0.01	(42, 76)	51.17	0.69	0.68	
2	15	27	64	(53, 95)	59.01	(52, 96)	59.03	0.04	(55, 93)	59.33	0.56	0.51	
2	3	81	64	(17, 37)	31.31	(16, 39)	31.33	0.06	(17, 38)	31.32	0.03	-0.03	*
2	7	81	64	(32, 62)	46.14	(31, 62)	46.23	0.19	(33, 62)	46.22	0.18	-0.01	*
2	11	81	64	(47, 83)	57.04	(46, 84)	57.05	0.02	(48, 82)	57.19	0.27	0.24	
2	15	81	64	(61, 102)	66.03	(60, 104)	66.08	0.08	(63, 100)	66.42	0.60	0.52	
4	3	3	64	(8, 32)	20.31	(8, 31)	20.33	0.14	(11, 33)	20.63	1.60	1.47	
4	7	3	64	(25, 61)	30.96	(25, 57)	31.17	0.67	(28, 60)	31.20	0.75	0.08	
4	11	3	64	(43, 87)	38.75	(43, 83)	38.90	0.37	(46, 84)	39.05	0.75	0.38	
4	15	3	64	(61, 111)	45.19	(62, 107)	45.36	0.38	(65, 108)	45.58	0.87	0.49	
4	3	9	64	(15, 37)	25.37	(14, 37)	25.41	0.16	(17, 38)	25.67	1.20	1.04	
4	7	9	64	(35, 68)	38.32	(34, 66)	38.46	0.35	(38, 67)	38.72	1.03	0.68	
4	11	9	64	(55, 96)	47.80	(54, 94)	47.91	0.22	(58, 93)	48.15	0.72	0.51	
4	15	9	64	(76, 122)	55.64	(75, 120)	55.67	0.06	(79, 118)	56.15	0.93	0.87	
4	3	27	64	(20, 42)	30.22	(20, 43)	30.23	0.04	(22, 42)	30.42	0.65	0.61	
4	7	27	64	(43, 75)	45.11	(42, 74)	45.22	0.24	(45, 74)	45.32	0.45	0.21	
4	11	27	64	(65, 104)	56.02	(64, 104)	56.10	0.14	(67, 101)	56.28	0.46	0.31	
4	15	27	64	(87, 131)	65.04	(85, 130)	65.24	0.30	(89, 127)	65.39	0.54	0.24	
4	3	81	64	(25, 47)	34.79	(25, 48)	34.82	0.08	(26, 47)	34.81	0.06	-0.02	*
4	7	81	64	(50, 81)	51.33	(49, 81)	51.43	0.20	(51, 80)	51.40	0.13	-0.06	*
4	11	81	64	(74, 111)	63.46	(73, 113)	63.51	0.08	(75, 109)	63.63	0.26	0.19	
4	15	81	64	(97, 140)	73.50	(95, 140)	73.64	0.19	(98, 136)	73.72	0.30	0.11	
AVERAGE % ERROR IN TOTAL EXE.CCST								0.15			1.07		
AVERAGE EXP.CCST FCR EACH CASE					36.82		36.87			37.16			
TOTAL EXP.CCST FCR EACH CASE					3534.39		3539.24			3567.32			
AVERAGE % ERROR DIFFERENCE NAC-ECW												0.92	
SUMMARY-AVERAGE EXE.CCST FCR EACH CASE					6019.30		6086.57			6099.57			
SUMMARY-TOTAL EXP.CCST FCR EACH CASE					31.35		31.70			31.77			
TOTAL AVERAGE % ERRCR IN TOTAL EXP.CCST								1.23			1.62		
TOTAL AVERAGE % ERROR DIFFERENCE NAC-ECW												0.39	

COMPARISON OF OPT. POWER & NADDOR APPROXIMATIONS

VARIANCE-TO-MEAN RATIO = 9

******* O R I G I N A L   C S D E F *******

IN THIS TABLE SET-UP COSTS ARE: 8 AND 16

EXP.COST IS EXP. TOTAL COST

L	M	PI	K	OPTIMAL POLICY (S,S)	OPTIMAL POLICY EXP.COST	POWER APPROXIMATION (S,S)	POWER EXP.COST	POWER ERROR	NADDOR APPROXIMATION (S,S)	NADDOR EXP.COST	NADDOR ERROR	COMPARISON NAD-POW	ND<PW
0	3	3	8	(-1, 6)	9.21	(2, 10)	9.59	8.49	(4, 11)	10.81	17.36	8.87	
0	7	3	8	(3, 14)	14.81	(5, 16)	15.10	1.99	(8, 17)	15.89	7.30	5.32	
0	11	3	8	(6, 20)	18.68	(9, 18)	18.96	1.52	(12, 21)	19.50	4.42	2.50	
0	15	3	8	(10, 25)	21.75	(13, 23)	22.04	1.31	(16, 25)	22.49	3.39	2.07	
0	3	9	8	(4, 12)	14.90	(7, 15)	15.61	4.75	(8, 15)	15.86	6.43	1.68	
0	7	9	8	(10, 21)	22.27	(13, 24)	22.74	2.12	(13, 22)	22.58	1.42	-0.70	*
0	11	9	8	(15, 28)	27.29	(18, 24)	28.17	3.25	(19, 27)	27.73	1.64	-1.61	*
0	15	9	8	(21, 35)	31.27	(23, 30)	32.06	2.52	(21, 32)	31.77	1.59	-0.93	*
0	3	27	8	(10, 19)	21.98	(12, 20)	22.15	0.79	(11, 18)	22.01	0.12	-0.67	*
0	7	27	8	(18, 30)	30.75	(20, 31)	30.88	0.42	(18, 26)	31.17	1.37	0.95	
0	11	27	8	(25, 38)	36.72	(26, 29)	40.11	9.25	(25, 32)	37.85	3.09	-6.15	*
0	15	27	8	(31, 45)	41.48	(33, 36)	44.65	7.63	(31, 37)	43.60	5.10	-2.53	*
0	3	81	8	(18, 26)	29.76	(17, 25)	29.81	0.18	(13, 21)	31.88	7.15	6.97	
0	7	81	8	(27, 39)	39.65	(28, 39)	39.67	0.05	(22, 30)	43.55	9.82	9.77	
0	11	81	8	(35, 48)	46.42	(32, 33)	58.38	25.77	(9, 37)	52.01	12.03	-13.73	*
0	15	81	8	(42, 55)	51.85	(40, 41)	62.29	20.13	(36, 42)	60.42	16.53	-3.61	*
2	3	3	8	(7, 16)	14.62	(11, 19)	15.32	4.79	(12, 19)	15.55	6.41	1.62	
2	7	3	8	(19, 33)	22.41	(25, 37)	23.30	3.96	(25, 34)	23.12	3.17	-0.79	*
2	11	3	8	(31, 48)	27.54	(38, 45)	29.05	3.98	(38, 48)	28.69	2.67	-1.31	*
2	15	3	8	(44, 63)	32.45	(51, 59)	33.56	3.42	(51, 61)	33.31	2.64	-0.78	*
2	3	9	8	(15, 24)	22.68	(18, 26)	23.04	1.61	(18, 25)	22.98	1.36	-0.25	*
2	7	9	8	(31, 44)	32.99	(35, 47)	33.50	1.55	(35, 42)	33.59	1.81	0.27	
2	11	9	8	(46, 61)	40.31	(50, 55)	41.92	3.97	(50, 58)	41.01	1.73	-2.24	*
2	15	9	8	(60, 77)	46.28	(65, 71)	47.70	3.06	(64, 72)	47.20	1.99	-1.07	*
2	3	27	8	(24, 33)	31.66	(26, 34)	31.81	0.47	(23, 30)	31.99	1.04	0.56	
2	7	27	8	(43, 56)	44.16	(46, 58)	44.51	0.79	(42, 50)	45.00	1.90	1.11	
2	11	27	8	(60, 75)	53.07	(63, 64)	57.51	8.37	(59, 67)	54.47	2.64	-5.73	*
2	15	27	8	(76, 92)	60.35	(80, 81)	64.27	6.49	(75, 82)	62.71	3.92	-2.58	*
2	3	81	8	(33, 43)	40.99	(36, 44)	41.25	0.65	(27, 34)	45.26	10.42	9.77	
2	7	81	8	(54, 67)	55.34	(61, 73)	56.93	2.87	(48, 56)	60.40	9.14	6.27	
2	11	81	8	(73, 88)	65.62	(71, 72)	75.02	14.33	(67, 74)	71.88	9.53	-4.79	*
2	15	81	8	(90, 106)	74.04	(89, 90)	82.97	12.05	(85, 91)	81.22	9.69	-2.36	*
4	3	3	8	(14, 24)	18.14	(20, 29)	19.28	6.29	(20, 27)	19.03	4.94	-1.35	*
4	7	3	8	(35, 51)	27.52	(43, 55)	28.71	4.32	(42, 51)	28.32	2.92	-1.40	*
4	11	3	8	(56, 75)	34.25	(65, 70)	36.17	5.61	(64, 73)	35.29	3.04	-2.57	*
4	15	3	8	(76, 98)	39.76	(87, 93)	41.63	4.71	(85, 95)	40.81	2.63	-2.08	*
4	3	9	8	(24, 34)	27.58	(29, 38)	28.42	3.05	(27, 34)	27.81	0.80	-2.24	*
4	7	9	8	(49, 64)	40.11	(55, 67)	40.77	1.66	(54, 61)	40.80	1.73	0.08	
4	11	9	8	(73, 91)	49.10	(80, 84)	51.18	4.24	(78, 86)	49.97	1.76	-2.47	*
4	15	9	8	(97, 116)	56.49	(103, 108)	58.42	3.42	(102, 110)	57.59	1.95	-1.48	*
4	3	27	8	(35, 45)	37.78	(39, 48)	38.46	1.81	(34, 40)	38.38	1.61	-0.21	*
4	7	27	8	(64, 78)	53.07	(69, 81)	53.81	1.39	(63, 71)	54.05	1.84	0.45	
4	11	27	8	(90, 106)	64.10	(94, 95)	68.59	7.01	(90, 98)	65.58	2.31	-4.69	*
4	15	27	8	(115, 133)	73.17	(121, 122)	76.92	5.13	(116, 123)	75.36	2.99	-2.14	*
4	3	81	8	(45, 55)	48.11	(52, 61)	49.63	3.57	(39, 46)	52.18	8.46	4.89	
4	7	81	8	(77, 91)	65.81	(89, 101)	69.77	6.02	(71, 79)	70.40	6.98	0.96	
4	11	81	8	(106, 121)	78.62	(104, 105)	87.58	11.39	(100, 108)	83.64	6.39	-5.01	*
4	15	81	8	(133, 150)	89.16	(132, 133)	97.42	9.26	(128, 134)	95.73	7.36	-1.89	*
0	3	3	16	(-1, 8)	10.96	(0, 11)	11.34	3.43	(2, 13)	12.26	11.80	8.37	

0	7	3	16	(1, 16)	17.50	(2, 18)	17.58	0.46	(6, 20)	18.58	6.17	5.71	
0	11	3	16	(4, 23)	22.09	(6, 25)	22.25	0.74	(9, 26)	22.88	3.61	2.86	
0	15	3	16	(7, 29)	25.79	(9, 33)	26.54	2.89	(13, 31)	26.60	3.13	0.23	
0	3	9	16	(3, 13)	16.54	(5, 16)	16.95	2.45	(7, 18)	17.79	7.55	5.10	
0	7	9	16	(8, 24)	24.94	(10, 26)	25.13	0.79	(12, 26)	25.51	2.31	1.52	
0	11	9	16	(13, 32)	30.75	(15, 34)	30.92	0.56	(17, 32)	31.19	1.45	0.89	
0	15	9	16	(18, 39)	35.42	(20, 30)	37.32	5.35	(22, 38)	35.88	1.29	-4.06	*
0	3	27	16	(9, 20)	23.55	(10, 21)	23.60	0.23	(10, 22)	23.67	0.50	0.27	
0	7	27	16	(17, 32)	33.41	(17, 33)	33.41	0.02	(17, 31)	33.45	0.12	0.10	
0	11	27	16	(23, 41)	40.21	(24, 43)	40.29	0.20	(23, 38)	40.44	0.57	0.36	
0	15	27	16	(29, 49)	45.70	(29, 36)	50.53	10.57	(29, 44)	46.17	1.03	-9.54	*
0	3	81	16	(15, 28)	31.31	(15, 26)	31.49	0.59	(12, 25)	32.57	4.04	3.45	
0	7	81	16	(25, 41)	42.31	(25, 41)	42.31	0.0	(21, 36)	43.97	3.92	3.92	
0	11	81	16	(33, 51)	49.93	(33, 52)	49.95	0.03	(29, 43)	52.59	5.33	5.30	
0	15	81	16	(40, 59)	56.11	(40, 41)	70.16	25.04	(35, 50)	58.97	5.10	-19.94	*
2	3	3	16	(5, 18)	16.06	(8, 20)	16.40	2.12	(11, 21)	17.21	7.13	5.01	
2	7	3	16	(17, 36)	24.71	(20, 37)	24.96	0.98	(23, 37)	25.56	3.41	2.43	
2	11	3	16	(28, 52)	30.87	(33, 54)	31.28	1.33	(36, 52)	31.90	3.34	2.01	
2	15	3	16	(40, 67)	35.51	(45, 69)	36.30	1.11	(48, 66)	36.90	2.78	1.67	
2	3	9	16	(13, 26)	24.14	(16, 28)	24.44	1.24	(17, 27)	24.57	1.77	0.54	
2	7	9	16	(29, 47)	35.38	(31, 49)	35.52	0.41	(33, 46)	35.89	1.45	1.04	
2	11	9	16	(43, 65)	43.39	(46, 67)	43.63	0.54	(47, 62)	43.94	1.26	0.71	
2	15	9	16	(57, 82)	49.95	(60, 84)	50.19	0.48	(62, 77)	50.86	1.82	1.34	
2	3	27	16	(22, 35)	33.13	(23, 35)	33.13	0.02	(22, 33)	33.23	0.30	0.28	
2	7	27	16	(41, 59)	46.60	(42, 59)	46.65	0.10	(40, 54)	47.02	0.89	0.79	
2	11	27	16	(57, 78)	56.24	(59, 80)	56.37	0.23	(57, 71)	57.21	1.73	1.50	
2	15	27	16	(73, 96)	64.15	(75, 99)	64.35	0.32	(73, 88)	65.28	1.76	1.44	
2	3	81	16	(32, 44)	42.45	(33, 45)	42.51	0.13	(26, 30)	45.11	6.25	6.13	
2	7	81	16	(52, 70)	57.81	(55, 72)	58.07	0.45	(47, 60)	61.20	5.85	5.40	
2	11	81	16	(71, 91)	68.86	(75, 96)	69.66	1.16	(65, 80)	72.33	5.04	3.88	
2	15	81	16	(88, 110)	77.94	(93, 117)	79.11	1.50	(82, 97)	82.17	5.42	3.93	
4	3	3	16	(12, 26)	19.49	(16, 28)	19.87	1.95	(18, 29)	20.36	4.45	2.49	
4	7	3	16	(32, 54)	29.66	(38, 56)	30.24	1.96	(40, 54)	30.66	3.37	1.41	
4	11	3	16	(52, 78)	36.98	(59, 80)	37.58	1.63	(61, 77)	38.11	3.05	1.42	
4	15	3	16	(72, 102)	42.58	(80, 104)	43.67	1.60	(82, 99)	44.33	3.15	1.55	
4	3	9	16	(22, 36)	28.98	(25, 37)	29.16	0.62	(26, 36)	29.31	1.15	0.53	
4	7	9	16	(47, 67)	42.36	(51, 69)	42.71	0.82	(52, 65)	42.97	1.45	0.63	
4	11	9	16	(70, 94)	52.01	(74, 95)	52.22	0.41	(76, 90)	52.96	1.83	1.42	
4	15	9	16	(93, 120)	59.93	(97, 121)	60.16	0.37	(99, 114)	61.13	2.00	1.62	
4	3	27	16	(33, 46)	39.18	(35, 47)	39.28	0.26	(33, 43)	39.46	0.71	0.45	
4	7	27	16	(61, 80)	55.40	(64, 82)	55.57	0.32	(61, 74)	56.19	1.43	1.11	
4	11	27	16	(87, 110)	67.12	(91, 112)	67.41	0.43	(88, 102)	68.24	1.68	1.25	
4	15	27	16	(112, 138)	76.77	(116, 140)	77.05	0.37	(113, 128)	78.22	1.89	1.52	
4	3	81	16	(44, 57)	49.53	(47, 59)	49.90	0.75	(38, 49)	52.51	6.01	5.26	
4	7	81	16	(75, 94)	68.18	(82, 100)	69.78	2.35	(70, 83)	71.29	4.56	2.21	
4	11	81	16	(103, 125)	81.71	(112, 133)	83.88	2.65	(98, 112)	85.60	4.76	2.11	
4	15	81	16	(130, 154)	92.87	(140, 164)	95.53	2.87	(125, 140)	96.82	4.26	1.39	
AVERAGE % ERROR IN TOTAL EXE.COST								3.40			3.96		
AVERAGE EXE.COST FOR EACH CASE					41.50		43.10			43.16			
TOTAL EXE.COST FOR EACH CASE					3983.71		4137.58			4143.46			
AVERAGE % ERROR DIFFERENCE BAE-FCW												0.56	

COMPARISON OF OPT. POWER & NADDOR APPROXIMATIONS

VARIANCE-TO-MEAN RATIO = 5

******* O R I G I N A L   O R D E R *******

IN THIS TABLE SET-UP COSTS ARE: 32 AND 64

EXP.COST IS EXP. TOTAL COST

L	M	PI	K	OPTIMAL POLICY (S,S)	OPTIMAL POLICY EXP.COST	POWER APPROXIMATION (S,S)	POWER APPROXIMATION EXP.COST	POWER APPROXIMATION ERROR	NADDOR APPROXIMATION (S,S)	NADDOR APPROXIMATION EXP.COST	NADDOR APPROXIMATION ERROR	COMPARISON NAD-POW	COMPARISON ND<PW
0	3	3	32	(-2, 11)	13.85	(-2, 13)	13.95	0.73	(1, 17)	15.30	10.52	5.79	
0	7	3	32	(-1, 21)	21.79	(0, 22)	21.84	0.23	(3, 25)	22.63	3.85	3.62	
0	11	3	32	(2, 29)	27.50	(1, 28)	27.51	0.01	(6, 32)	28.24	2.68	2.67	
0	15	3	32	(4, 35)	32.15	(4, 35)	32.15	0.0	(9, 38)	32.81	2.03	2.03	
0	3	9	32	(2, 16)	19.19	(3, 18)	19.38	0.99	(5, 22)	20.44	6.50	5.51	
0	7	9	32	(6, 28)	29.20	(7, 29)	29.22	0.08	(10, 32)	29.92	2.47	2.40	
0	11	9	32	(11, 37)	36.24	(12, 39)	36.32	0.23	(14, 39)	36.61	1.03	0.80	
0	15	9	32	(15, 45)	41.97	(16, 47)	42.03	0.14	(19, 46)	42.40	1.04	0.89	
0	3	27	32	(6, 23)	26.11	(8, 23)	26.11	0.0	(9, 26)	26.39	1.06	1.06	
0	7	27	32	(15, 37)	37.65	(15, 37)	37.65	0.0	(15, 38)	37.68	0.08	0.08	
0	11	27	32	(21, 47)	45.75	(21, 48)	45.77	0.04	(21, 46)	45.76	0.02	-0.02	*
0	15	27	32	(26, 55)	52.35	(26, 57)	52.38	0.06	(27, 54)	52.39	0.07	0.02	
0	3	81	32	(15, 31)	33.82	(13, 28)	34.17	1.04	(12, 31)	34.24	1.25	0.21	
0	7	81	32	(24, 46)	46.55	(22, 44)	46.68	0.29	(20, 43)	47.28	1.56	1.27	
0	11	81	32	(31, 57)	55.51	(30, 57)	55.51	0.02	([illegible], 53)	56.31	1.45	1.43	
0	15	81	32	(37, 66)	62.81	(36, 67)	62.87	0.10	(33, 61)	63.91	1.74	1.64	
2	3	3	32	(3, 21)	18.42	(4, 21)	18.43	0.03	(9, 25)	19.66	6.73	6.70	
2	7	3	32	(14, 40)	28.38	(15, 39)	28.44	0.18	(20, 42)	29.21	2.93	2.74	
2	11	3	32	(25, 57)	35.53	(27, 56)	35.64	0.32	(32, 58)	36.46	2.61	2.29	
2	15	3	32	(36, 73)	41.39	(38, 71)	41.51	0.30	(43, 72)	42.22	2.00	1.70	
2	3	9	32	(12, 29)	26.50	(13, 30)	26.59	0.33	(15, 31)	26.96	1.71	1.38	
2	7	9	32	(26, 51)	39.19	(27, 51)	39.21	0.04	(30, 51)	39.58	1.00	0.95	
2	11	9	32	(40, 70)	48.29	(41, 70)	48.32	0.05	(44, 69)	48.71	0.86	0.81	
2	15	9	32	(53, 88)	55.77	(54, 87)	55.78	0.03	(58, 85)	56.34	1.03	1.00	
2	3	27	32	(21, 38)	35.49	(21, 38)	35.49	0.0	(21, 37)	35.50	0.02	0.02	
2	7	27	32	(38, 63)	50.50	(38, 62)	50.51	0.02	(38, 59)	50.73	0.46	0.44	
2	11	27	32	(54, 84)	61.29	(54, 83)	61.30	0.01	(55, 78)	61.77	0.78	0.77	
2	15	27	32	(70, 103)	70.18	(70, 103)	70.18	0.0	(70, 96)	70.72	0.78	0.78	
2	3	81	32	(30, 47)	44.82	(29, 46)	44.90	0.16	(25, 42)	46.67	4.11	3.95	
2	7	81	32	(50, 74)	61.76	(51, 75)	61.79	0.05	(45, 67)	63.71	3.15	3.10	
2	11	81	32	(68, 97)	74.01	(69, 98)	74.07	0.08	(63, 87)	76.20	2.97	2.89	
2	15	81	32	(85, 117)	84.10	(87, 120)	84.36	0.31	(80, 106)	86.28	2.60	2.29	
4	3	3	32	(10, 29)	21.67	(12, 29)	21.76	0.38	(16, 32)	22.59	4.24	3.86	
4	7	3	32	(29, 58)	33.09	(32, 57)	33.24	0.47	(37, 58)	34.17	3.26	2.79	
4	11	3	32	(48, 84)	41.32	(52, 82)	41.55	0.56	(57, 83)	42.41	2.64	2.08	
4	15	3	32	(68, 109)	48.09	(72, 107)	48.33	0.51	(77, 106)	49.27	2.46	1.95	
4	3	9	32	(21, 39)	31.22	(22, 39)	31.27	0.17	(25, 40)	31.77	1.76	1.59	
4	7	9	32	(44, 71)	45.97	(46, 71)	46.03	0.12	(43, 69)	46.56	1.28	1.16	
4	11	9	32	(67, 100)	56.62	(65, 99)	56.70	0.15	(72, 96)	57.32	1.24	1.10	
4	15	9	32	(89, 127)	65.40	(91, 126)	65.45	0.08	(95, 121)	66.38	1.51	1.43	
4	3	27	32	(31, 49)	41.46	(32, 49)	41.47	0.03	(31, 47)	41.55	0.22	0.20	
4	7	27	32	(59, 85)	59.11	(60, 85)	59.14	0.05	(59, 80)	59.46	0.60	0.54	
4	11	27	32	(84, 116)	71.91	(85, 115)	71.93	0.02	(85, 108)	72.71	1.11	1.09	
4	15	27	32	(109, 144)	82.47	(110, 145)	82.50	0.04	(110, 135)	83.53	1.29	1.25	
4	3	81	32	(42, 60)	51.83	(43, 60)	51.86	0.06	(37, 53)	53.84	3.87	3.81	
4	7	81	32	(73, 98)	71.98	(75, 100)	72.18	0.28	(68, 88)	74.32	3.26	2.97	
4	11	81	32	(100, 131)	86.63	(104, 134)	87.07	0.51	(96, 119)	89.06	2.81	2.30	
4	15	81	32	(127, 161)	96.74	(132, 167)	95.67	0.95	(122, 148)	101.31	2.61	1.66	
0	3	3	64	(-4, 15)	18.32	(-5, 17)	18.46	0.77	(-1, 22)	19.44	6.11	5.33	
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	

0	7	3	64	(-3, 27)	28.47	(-5, 26)	28.66	0.64	(0, 33)	29.18	2.48	1.84
0	11	3	64	(-1, 37)	35.85	(-3, 35)	35.95	0.29	(1, 41)	36.19	0.96	0.67
0	15	3	64	(1, 45)	41.92	(0, 44)	41.53	0.02	(3, 48)	42.14	0.54	0.52
0	3	9	64	(0, 20)	23.37	(1, 23)	23.53	0.68	(4, 28)	25.02	7.05	6.37
0	7	9	64	(4, 35)	35.83	(4, 35)	35.83	0.0	(8, 40)	36.71	2.45	2.45
0	11	9	64	(8, 46)	44.73	(8, 46)	44.73	0.0	(12, 50)	45.39	1.49	1.49
0	15	9	64	(12, 55)	52.01	(12, 56)	52.02	0.02	(16, 58)	52.54	1.01	0.99
0	3	27	64	(6, 27)	30.15	(7, 29)	30.26	0.36	(8, 33)	30.89	2.42	2.06
0	7	27	64	(13, 43)	44.27	(13, 44)	44.27	0.01	(14, 47)	44.52	0.56	0.55
0	11	27	64	(18, 55)	54.30	(18, 56)	54.30	0.01	(20, 58)	54.50	0.38	0.37
0	15	27	64	(23, 66)	62.53	(23, 67)	62.55	0.03	(25, 67)	62.64	0.16	0.14
0	3	81	64	(13, 35)	37.60	(12, 34)	37.89	0.24	(11, 38)	38.22	1.10	0.87
0	7	81	64	(21, 52)	53.14	(20, 51)	53.25	0.20	(19, 54)	53.45	0.58	0.38
0	11	81	64	(28, 65)	64.08	(27, 65)	64.14	0.09	(26, 66)	64.29	0.33	0.24
0	15	81	64	(34, 76)	73.07	(33, 77)	73.15	0.11	(33, 76)	73.14	0.10	-0.01
2	3	3	64	(1, 25)	22.15	(1, 24)	22.16	0.02	(6, 29)	23.09	4.24	4.22
2	7	3	64	(11, 47)	34.15	(10, 44)	34.23	0.23	(16, 49)	34.64	2.02	1.79
2	11	3	64	(21, 65)	42.82	(20, 61)	42.99	0.40	(27, 66)	43.56	1.73	1.33
2	15	3	64	(31, 82)	49.94	(31, 78)	50.10	0.32	(37, 82)	50.53	1.17	0.85
2	3	9	64	(10, 33)	30.25	(10, 33)	30.25	0.0	(14, 36)	31.02	2.56	2.56
2	7	9	64	(23, 58)	45.18	(23, 57)	45.19	0.01	(27, 59)	45.56	0.84	0.83
2	11	9	64	(36, 79)	55.95	(36, 77)	55.97	0.04	(41, 78)	56.45	0.89	0.85
2	15	9	64	(49, 97)	64.81	(45, 96)	64.83	0.03	(54, 95)	65.35	0.83	0.81
2	3	27	64	(19, 42)	39.26	(18, 41)	39.29	0.10	(19, 43)	39.28	0.06	-0.04
2	7	27	64	(36, 69)	56.61	(35, 69)	56.62	0.02	(36, 68)	56.63	0.03	0.01
2	11	27	64	(51, 92)	69.16	(50, 91)	69.20	0.06	(52, 89)	69.27	0.16	0.10
2	15	27	64	(66, 112)	79.51	(65, 112)	79.53	0.02	(67, 108)	79.72	0.26	0.23
2	3	81	64	(28, 51)	48.59	(27, 50)	48.68	0.18	(24, 49)	49.53	1.92	1.74
2	7	81	64	(48, 81)	67.96	(47, 81)	67.97	0.01	(44, 76)	68.75	1.16	1.15
2	11	81	64	(65, 105)	82.01	(64, 105)	82.03	0.02	(61, 99)	82.90	1.08	1.05
2	15	81	64	(81, 126)	93.63	(81, 128)	93.65	0.02	(78, 119)	94.48	0.91	0.69
4	3	3	64	(8, 33)	25.15	(8, 32)	25.17	0.07	(14, 36)	26.20	4.17	4.10
4	7	3	64	(25, 64)	38.49	(26, 61)	38.60	0.30	(32, 65)	39.25	1.98	1.68
4	11	3	64	(44, 92)	48.14	(45, 88)	48.29	0.32	(52, 91)	49.16	2.12	1.80
4	15	3	64	(62, 118)	56.09	(64, 113)	56.31	0.38	(71, 115)	57.16	1.90	1.52
4	3	9	64	(18, 43)	34.79	(19, 43)	34.79	0.02	(22, 45)	35.22	1.23	1.22
4	7	9	64	(41, 78)	51.65	(41, 76)	51.68	0.06	(46, 77)	52.19	1.06	0.99
4	11	9	64	(63, 108)	63.87	(63, 106)	63.90	0.06	(68, 105)	64.45	0.91	0.85
4	15	9	64	(85, 136)	73.95	(84, 133)	74.03	0.11	(90, 131)	74.70	1.02	0.91
4	3	27	64	(29, 53)	45.08	(29, 53)	45.08	0.0	(29, 52)	45.10	0.06	0.06
4	7	27	64	(56, 91)	64.96	(55, 90)	65.00	0.06	(56, 87)	65.18	0.34	0.28
4	11	27	64	(81, 124)	79.42	(80, 123)	79.44	0.02	(82, 118)	79.81	0.49	0.47
4	15	27	64	(105, 154)	91.36	(103, 152)	91.45	0.09	(106, 146)	91.96	0.65	0.56
4	3	81	64	(40, 64)	55.48	(39, 63)	55.52	0.08	(35, 59)	56.94	2.63	2.55
4	7	81	64	(70, 104)	77.94	(70, 105)	77.94	0.00	(65, 97)	79.43	1.91	1.91
4	11	81	64	(97, 139)	94.31	(96, 141)	94.39	0.08	(93, 129)	95.81	1.59	1.51
4	15	81	64	(123, 170)	107.86	(124, 173)	107.95	0.08	(119, 159)	109.49	1.51	1.43

AVERAGE % ERROR IN TOTAL EXP.COST				0.18			1.84	
AVERAGE EXP.COST FOR EACH CASE	50.58		50.66			51.36		
TOTAL EXP.COST FOR EACH CASE	4855.94		4863.36			4930.52		
AVERAGE % ERROR DIFFERENCE BAD-FCW								1.66
SUMMARY-AVERAGE EXP.COST FOR EACH CASE	8839.64		9000.95			9073.98		
SUMMARY-TOTAL EXP.COST FOR EACH CASE	46.04		46.89			47.26		
TOTAL AVERAGE % ERROR IN TOTAL EXP.COST				1.79			2.90	
TOTAL AVERAGE % ERROR DIFFERENCE NAE-FCW								1.11

APPENDIX B

Single-Item Policies and Costs

In this appendix, the listed items are ordered by the percentage difference between optimal and Power Approximation total costs.

COMPARISON OF OPT. POWER & NADDOR APPROXIMATIONS

VARIANCE-TO-MEAN RATIO = 1

*** ORDERED BY POWER APPROXIMATION ERROR ***

IN THIS TABLE SET-UP COSTS ARE: 8 AND 16

EXP.COST IS EXP. TOTAL COST

L	M	PI	K	OPTIMAL POLICY (S,S)	OPTIMAL POLICY EXP.COST	POWER APPROXIMATION (S,S)	POWER APPROXIMATION EXP.COST	POWER APPROXIMATION ERROR	NADDOR APPROXIMATION (S,S)	NADDOR APPROXIMATION EXP.COST	NADDOR APPROXIMATION ERROR	COMPARISON NAD-POW	COMPARISON ND<PW
0	11	9	8	(10, 15)	14.13	(10, 15)	14.13	0.0	(12, 19)	15.52	9.85	9.85	
0	11	27	8	(13, 17)	15.88	(13, 17)	15.88	0.0	(14, 20)	16.96	6.77	6.77	
0	15	81	8	(20, 24)	18.97	(20, 24)	18.97	0.0	(22, 25)	19.05	0.45	0.45	
2	15	9	8	(46, 54)	20.10	(46, 54)	20.10	0.0	(48, 55)	20.27	0.84	0.84	
2	15	27	8	(51, 57)	23.40	(51, 57)	23.40	0.0	(53, 58)	23.41	0.07	0.07	
4	7	9	8	(37, 48)	16.49	(37, 48)	16.49	0.0	(39, 46)	17.20	4.30	4.30	
4	15	9	8	(78, 86)	23.51	(78, 86)	23.51	0.0	(80, 88)	23.74	0.96	0.96	
4	3	27	8	(19, 26)	13.12	(19, 26)	13.12	0.0	(20, 26)	13.41	2.21	2.21	
0	3	9	16	(2, 11)	10.36	(2, 11)	10.36	0.0	(3, 12)	10.72	3.48	3.48	
0	15	27	16	(16, 22)	25.12	(16, 22)	25.12	0.0	(18, 31)	27.58	9.80	9.80	
0	3	81	16	(5, 14)	12.80	(5, 14)	12.80	0.0	(7, 15)	14.25	11.29	11.29	
0	15	81	16	(19, 24)	26.96	(19, 24)	26.96	0.0	(22, 33)	31.61	17.22	17.22	
2	3	27	16	(11, 21)	13.80	(11, 21)	13.80	0.0	(12, 21)	14.07	2.00	2.00	
4	7	9	16	(36, 51)	19.88	(36, 51)	19.88	0.0	(38, 49)	20.50	3.12	3.12	
4	11	9	16	(56, 74)	24.71	(56, 74)	24.71	0.0	(58, 71)	25.37	2.71	2.71	
4	3	27	16	(18, 28)	15.39	(18, 28)	15.39	0.0	(20, 28)	16.06	4.37	4.37	
0	15	27	8	(18, 22)	17.13	(17, 22)	17.13	0.00	(19, 23)	17.22	0.48	0.48	
0	15	3	8	(10, 18)	13.05	(11, 18)	13.05	0.00	(11, 20)	13.69	4.93	4.93	
0	15	9	8	(15, 20)	15.12	(14, 20)	15.12	0.00	(16, 22)	15.74	4.13	4.12	
2	3	81	16	(13, 22)	15.50	(13, 23)	15.50	0.00	(14, 23)	15.84	2.21	2.21	
4	15	27	8	(84, 91)	27.66	(83, 91)	27.67	0.04	(86, 92)	27.78	0.44	0.40	
2	3	9	16	(8, 19)	11.93	(9, 19)	11.94	0.06	(10, 19)	12.25	2.62	2.56	
4	7	81	16	(43, 57)	26.25	(43, 58)	26.28	0.09	(45, 56)	26.72	1.75	1.66	
4	11	81	16	(65, 82)	32.57	(65, 83)	32.61	0.12	(67, 79)	33.46	2.74	2.62	
2	3	9	8	(9, 17)	9.61	(9, 16)	9.63	0.14	(11, 17)	10.10	5.13	4.99	
2	7	9	16	(21, 35)	18.08	(21, 36)	18.11	0.16	(22, 34)	18.31	1.28	1.12	
4	7	27	8	(41, 51)	19.74	(41, 52)	19.77	0.16	(43, 49)	20.73	5.05	4.88	
2	7	27	16	(24, 38)	20.84	(24, 39)	20.89	0.22	(26, 37)	21.39	2.65	2.43	
0	11	3	8	(7, 14)	12.18	(7, 13)	12.21	0.22	(8, 17)	12.81	5.19	4.97	
4	11	81	8	(66, 73)	28.07	(67, 72)	28.14	0.22	(68, 74)	28.32	0.89	0.67	
2	11	9	16	(33, 50)	22.45	(33, 51)	22.50	0.24	(34, 48)	22.74	1.30	1.06	
4	7	27	16	(40, 54)	23.27	(39, 54)	23.32	0.25	(42, 53)	23.86	2.57	2.32	
2	15	3	8	(40, 50)	16.56	(42, 50)	16.60	0.25	(43, 52)	16.98	2.53	2.27	
2	3	3	16	(6, 17)	9.80	(6, 16)	9.82	0.26	(7, 17)	9.99	1.93	1.67	
2	11	81	16	(40, 57)	28.85	(40, 58)	28.93	0.28	(42, 54)	29.74	3.06	2.78	
2	3	3	8	(6, 15)	7.66	(7, 14)	7.68	0.28	(9, 15)	8.29	8.16	7.88	
2	11	3	16	(27, 45)	18.53	(28, 46)	18.58	0.29	(29, 44)	18.79	1.39	1.10	
4	11	27	16	(61, 78)	28.88	(60, 78)	28.98	0.33	(63, 76)	29.49	2.12	1.79	
2	11	27	16	(37, 53)	25.86	(37, 55)	25.95	0.35	(39, 51)	26.86	3.87	3.52	
2	15	81	8	(55, 61)	26.34	(55, 60)	26.44	0.36	(56, 61)	26.35	0.01	-0.35	
4	3	9	16	(15, 26)	13.09	(15, 25)	13.14	0.39	(17, 26)	13.51	3.24	2.85	
4	3	9	8	(16, 24)	10.90	(16, 23)	10.94	0.39	(18, 24)	11.43	4.81	4.42	
2	11	81	8	(41, 47)	23.78	(42, 46)	23.87	0.39	(43, 49)	24.46	2.86	2.47	
4	7	3	16	(30, 47)	16.03	(31, 46)	16.09	0.40	(33, 46)	16.50	2.94	2.55	
0	3	81	8	(5, 11)	10.13	(5, 12)	10.17	0.40	(6, 12)	10.57	4.36	3.96	
2	7	3	16	(16, 32)	14.88	(17, 32)	14.94	0.42	(18, 31)	15.16	1.88	1.46	
0	3	3	16	(0, 10)	8.89	(0, 9)	8.93	0.42	(1, 10)	9.15	2.88	2.46	
2	7	81	16	(27, 40)	23.29	(27, 42)	23.38	0.44	(29, 40)	23.99	3.03	2.59	
4	3	81	16	(20, 30)	17.46	(21, 31)	17.54	0.45	(22, 30)	17.99	3.05	2.60	

0	7	27	16	(8, 20)	17.56	(8, 22)	17.65	0.49	(10, 21)	18.50	5.35	4.86	
0	3	27	8	(4, 10)	9.09	(4, 11)	9.13	0.50	(5, 11)	9.58	5.44	4.93	
4	7	3	8	(32, 44)	12.90	(33, 44)	12.97	0.53	(35, 43)	13.60	5.36	4.83	
0	7	3	16	(2, 16)	13.51	(3, 17)	13.59	0.60	(3, 17)	13.59	0.60	0.0	
2	3	27	8	(11, 18)	11.43	(12, 19)	11.50	0.61	(13, 18)	11.98	4.82	4.21	
4	11	3	16	(49, 69)	19.99	(51, 69)	20.11	0.63	(52, 67)	20.38	1.97	1.34	
0	3	3	8	(0, 8)	6.55	(1, 8)	6.59	0.63	(2, 8)	6.94	5.92	5.28	
4	15	81	8	(89, 95)	31.41	(89, 94)	31.61	0.64	(90, 96)	31.50	0.28	-0.36	•
0	7	9	16	(5, 19)	15.72	(6, 20)	15.83	0.66	(7, 19)	16.10	2.39	1.73	
2	11	9	8	(34, 41)	18.21	(34, 40)	18.34	0.70	(36, 43)	18.66	2.46	1.76	
2	11	27	8	(38, 44)	21.14	(38, 43)	21.29	0.70	(40, 46)	21.71	2.69	1.99	
0	7	81	16	(10, 22)	19.19	(10, 24)	19.33	0.72	(12, 23)	20.35	6.03	5.31	
4	15	3	8	(71, 83)	18.91	(73, 81)	19.05	0.78	(74, 83)	19.25	1.82	1.04	
4	11	27	8	(62, 70)	24.73	(62, 69)	24.92	0.79	(6[illegible], 71)	25.04	1.26	0.47	
4	3	3	16	(12, 24)	10.55	(12, 22)	10.64	0.86	(14, 23)	11.03	4.54	3.67	
4	7	81	8	(44, 54)	22.63	(45, 56)	22.88	1.07	(46, 52)	23.51	3.89	2.82	
4	3	3	8	(13, 21)	8.53	(13, 20)	8.63	1.22	(15, 21)	9.01	5.66	4.44	
0	3	27	16	(3, 13)	11.61	(4, 13)	11.77	1.37	(5, 14)	12.41	6.89	5.52	
2	3	81	8	(13, 20)	13.02	(14, 21)	13.21	1.44	(15, 20)	13.75	5.55	4.11	
4	11	9	8	(57, 71)	20.65	(57, 65)	21.01	1.74	(60, 67)	21.39	3.59	1.86	
4	3	81	8	(21, 28)	15.09	(22, 29)	15.34	1.75	(22, 28)	15.32	1.61	-0.14	•
0	15	9	16	(13, 23)	22.66	(13, 20)	23.08	1.87	(14, 28)	24.23	6.95	5.08	
0	3	9	8	(2, 9)	7.86	(3, 10)	8.06	2.64	(4, 9)	8.60	9.49	6.85	
0	11	81	8	(15, 19)	17.46	(15, 19)	17.93	2.65	(17, 22)	19.01	8.86	6.21	
2	15	81	16	(54, 74)	33.50	(53, 60)	34.42	2.76	(56, 68)	36.17	7.98	5.22	
0	7	27	8	(8, 19)	13.73	(9, 12)	14.21	3.50	(10, 16)	14.63	6.58	3.08	
0	7	81	8	(10, 19)	15.25	(11, 13)	15.79	3.52	(12, 18)	16.45	7.82	4.30	
2	11	3	8	(29, 42)	14.53	(30, 37)	15.08	3.81	(31, 40)	15.02	3.40	-0.41	•
2	15	27	16	(50, 70)	30.06	(49, 57)	31.34	4.29	(52, 64)	32.52	8.18	3.90	
4	15	81	16	(87, 105)	37.82	(87, 94)	39.58	4.63	(89, 102)	39.76	5.12	0.49	
4	15	27	16	(82, 103)	33.56	(81, 91)	35.50	5.80	(84, 97)	35.38	5.44	-0.36	•
0	15	3	16	(8, 30)	19.57	(9, 18)	20.80	6.32	(9, 26)	20.08	2.62	-3.70	•
4	11	3	8	(51, 66)	16.12	(53, 60)	17.16	6.44	(54, 63)	16.89	4.79	-1.65	•
2	7	81	8	(28, 37)	19.59	(28, 31)	20.88	6.56	(29, 35)	20.24	3.28	-3.28	•
2	15	9	16	(45, 66)	26.10	(45, 54)	27.87	6.79	(47, 61)	27.66	5.99	-0.80	•
2	7	27	8	(25, 33)	17.19	(25, 29)	18.40	7.01	(27, 33)	18.17	5.68	-1.33	•
2	7	9	8	(22, 32)	14.55	(22, 27)	15.59	7.18	(24, 31)	15.33	5.36	-1.81	•
0	7	3	8	(3, 13)	9.96	(4, 9)	10.68	7.20	(5, 13)	10.29	3.23	-3.98	•
0	7	9	8	(6, 15)	11.96	(7, 10)	12.84	7.32	(8, 15)	12.67	5.89	-1.44	•
4	15	9	16	(76, 97)	28.69	(76, 86)	31.14	8.52	(78, 93)	29.78	3.78	-4.74	•
2	7	3	8	(18, 29)	11.60	(18, 24)	12.70	9.51	(20, 28)	12.10	4.31	-5.20	•
0	11	81	16	(14, 30)	23.64	(15, 19)	25.92	9.61	(17, 29)	25.26	6.85	-2.76	•
0	11	27	16	(12, 28)	21.70	(12, 17)	23.79	9.63	(14, 26)	22.80	5.07	-4.56	•
2	15	3	16	(32, 60)	21.51	(40, 50)	24.04	11.74	(40, 57)	21.99	2.23	-9.51	•
0	11	9	16	(9, 25)	19.47	(9, 15)	21.92	12.54	(11, 24)	20.09	3.15	-9.39	•
4	15	3	16	(68, 91)	23.17	(70, 81)	26.12	12.71	(71, 88)	23.75	2.51	-10.21	•
0	11	3	16	(5, 22)	16.73	(6, 13)	19.64	16.91	(6, 21)	16.94	0.86	-16.06	•

AVERAGE % ERROR IN TOTAL EXP.COST			2.17		4.05
AVERAGE EXP.COST FOR EACH CASE	13.54	18.96		19.26	
TOTAL EXP.COST FOR EACH CASE	1779.46	1820.34		1849.33	
AVERAGE % ERROR DIFFERENCE RAT-PCM					1.88

COMPARISON OF OPT. POWER & NADDOR APPROXIMATIONS

VARIANCE-TO-MEAN RATIO = 1

*** ORDERED BY POWER APPROXIMATION ERROR ***

IN THIS TABLE SET-UP COSTS ARE: 32 AND 64

EXP.COST IS EXP. TOTAL COST

L	M	PI	K	OPTIMAL POLICY (S,S)	OPTIMAL POLICY EXP.COST	POWER APPROXIMATION (S,S)	POWER APPROXIMATION EXP.COST	POWER APPROXIMATION ERROR	NADDOR APPROXIMATION (S,S)	NADDOR APPROXIMATION EXP.COST	NADDOR APPROXIMATION ERROR	COMPARISON NAD-POW	COMPARISON ND<PW
0	3	27	32	(3, 16)	15.31	(3, 16)	15.31	0.0	(5, 18)	16.44	7.33	7.33	
0	7	27	32	(7, 26)	23.29	(7, 26)	23.29	0.0	(9, 27)	24.00	3.07	3.07	
0	7	81	32	(9, 28)	24.96	(9, 28)	24.96	0.0	(12, 30)	26.63	6.69	6.69	
0	11	81	32	(14, 37)	31.31	(14, 37)	31.31	0.0	(18, 38)	34.04	8.72	8.72	
2	3	9	32	(8, 22)	15.33	(8, 22)	15.33	0.0	(9, 23)	15.57	1.53	1.53	
2	7	9	32	(19, 40)	23.34	(19, 40)	23.34	0.0	(21, 40)	23.60	1.13	1.13	
2	3	27	32	(10, 24)	17.33	(10, 24)	17.33	0.0	(12, 25)	17.91	3.39	3.39	
2	3	81	32	(12, 26)	19.07	(12, 26)	19.07	0.0	(14, 27)	19.75	3.51	3.51	
2	11	81	32	(39, 64)	36.08	(39, 64)	36.08	0.0	(42, 63)	36.94	2.39	2.39	
4	3	9	32	(14, 29)	16.39	(14, 29)	16.39	0.0	(16, 29)	16.77	2.26	2.26	
4	3	27	32	(17, 32)	18.82	(17, 32)	18.82	0.0	(19, 32)	19.28	2.46	2.46	
4	7	81	32	(42, 63)	31.68	(42, 63)	31.68	0.0	(45, 62)	32.59	2.88	2.88	
0	3	81	64	(4, 23)	21.90	(4, 23)	21.90	0.0	(8, 27)	25.07	14.47	14.47	
0	11	81	64	(13, 46)	41.64	(13, 46)	41.64	0.0	(19, 51)	45.88	10.19	10.19	
2	3	9	64	(7, 27)	20.35	(7, 27)	20.35	0.0	([illegible], 28)	20.54	0.96	0.96	
2	7	27	64	(22, 51)	34.23	(22, 51)	34.23	0.0	(25, 52)	35.23	2.91	2.91	
2	7	81	64	(25, 54)	36.93	(25, 54)	36.93	0.0	(29, 56)	38.71	4.84	4.84	
2	11	81	64	(38, 73)	46.17	(38, 73)	46.17	0.0	(43, 75)	48.34	4.70	4.70	
4	3	9	64	(13, 34)	21.28	(13, 34)	21.28	0.0	(15, 34)	21.64	1.71	1.71	
4	15	9	64	(72, 114)	47.33	(72, 114)	47.33	0.0	(73, 111)	47.49	0.35	0.35	
4	3	27	64	(16, 37)	23.89	(16, 37)	23.89	0.0	(19, 37)	24.77	3.69	3.69	
4	7	27	64	(37, 67)	36.32	(37, 67)	36.32	0.0	(40, 67)	36.94	1.72	1.72	
4	7	81	64	(41, 71)	39.59	(41, 71)	39.59	0.0	(45, 72)	41.05	3.69	3.69	
2	15	9	64	(41, 82)	45.25	(41, 81)	45.26	0.00	(42, 80)	45.37	0.26	0.26	
4	11	9	32	(54, 81)	31.18	(54, 80)	31.18	0.00	(56, 78)	31.56	1.20	1.20	
4	11	9	64	(52, 90)	40.60	(52, 89)	40.60	0.01	(54, 87)	40.92	0.80	0.79	
2	11	9	32	(31, 57)	29.19	(31, 56)	29.19	0.01	(33, 55)	29.56	1.25	1.24	
2	11	27	64	(34, 70)	42.85	(34, 69)	42.86	0.02	(37, 70)	43.47	1.45	1.43	
0	11	27	32	(11, 35)	29.20	(11, 34)	29.20	0.02	(14, 35)	30.40	4.12	4.11	
4	11	81	32	(64, 89)	39.55	(64, 90)	39.56	0.03	(67, 87)	40.45	2.28	2.26	
2	7	27	32	(23, 43)	26.30	(23, 44)	26.30	0.03	(25, 43)	26.79	1.86	1.83	
2	3	81	64	(12, 31)	24.35	(12, 32)	24.36	0.03	(15, 34)	26.21	7.64	7.61	
2	3	27	64	(10, 30)	22.54	(9, 29)	22.55	0.03	(12, 31)	23.50	4.27	4.24	
0	11	9	32	(6, 32)	26.70	(6, 31)	26.71	0.04	(9, 31)	26.85	0.56	0.52	
0	11	27	64	(10, 44)	39.46	(10, 43)	39.47	0.04	(14, 46)	41.20	4.40	4.37	
2	15	81	64	(51, 90)	53.64	(51, 91)	53.66	0.04	(56, 92)	55.54	3.53	3.50	
0	15	81	64	(17, 55)	48.33	(17, 54)	48.35	0.04	(24, 60)	52.81	9.27	9.23	
2	7	9	64	(18, 48)	31.03	(18, 47)	31.04	0.05	(19, 47)	31.15	0.40	0.35	
4	7	9	32	(34, 56)	24.93	(34, 55)	24.95	0.07	(36, 55)	25.23	1.20	1.13	
0	11	9	64	(7, 42)	36.74	(7, 40)	36.76	0.07	(7, 41)	36.74	0.01	-0.07	
4	3	81	64	(19, 39)	26.08	(19, 40)	26.10	0.07	(22, 41)	27.43	5.20	5.13	
0	7	9	32	(4, 24)	21.32	(5, 24)	21.33	0.08	(6, 24)	21.63	1.48	1.40	
2	7	81	32	(26, 46)	28.85	(26, 47)	28.88	0.09	(29, 46)	30.09	4.29	4.20	
0	7	81	64	(8, 36)	33.34	(9, 36)	33.37	0.09	(13, 40)	36.36	9.06	8.96	
0	15	27	64	(14, 52)	45.83	(14, 51)	45.87	0.09	(18, 54)	47.32	3.27	3.18	
2	11	9	64	(29, 66)	38.85	(29, 64)	38.89	0.10	(31, 64)	39.11	0.65	0.55	
4	7	9	64	(33, 63)	32.45	(32, 62)	32.48	0.11	(34, 62)	32.63	0.55	0.44	
4	11	27	32	(60, 85)	35.68	(59, 85)	35.72	0.11	(62, 83)	36.25	1.60	1.49	
2	15	27	64	(47, 86)	49.82	(46, 86)	49.88	0.11	(50, 86)	50.64	1.64	1.53	

4	15	27	64	(79, 119)	52.85	(78, 120)	52.92	0.13	(82, 118)	53.55	1.31	1.19	
4	7	27	32	(39, 60)	29.55	(39, 59)	28.59	0.14	(41, 59)	29.13	2.02	1.87	
4	3	81	32	(20, 34)	20.95	(20, 35)	20.99	0.16	(22, 34)	21.85	4.26	4.10	
2	11	27	32	(36, 60)	32.90	(35, 60)	32.96	0.16	(38, 59)	33.52	1.86	1.70	
4	3	3	64	(9, 31)	18.18	(9, 30)	18.21	0.17	(10, 31)	18.30	0.64	0.48	
0	3	9	64	(0, 20)	19.22	(0, 19)	19.26	0.18	(2, 21)	19.65	2.22	2.03	
4	15	9	32	(74, 101)	36.34	(74, 104)	36.42	0.21	(76, 100)	36.54	0.54	0.33	
0	7	9	64	(3, 32)	29.33	(4, 31)	29.39	0.22	(4, 32)	29.36	0.12	-0.10	•
0	3	9	32	(1, 15)	13.95	(1, 14)	13.98	0.22	(3, 16)	14.66	5.06	4.84	
0	7	27	64	(6, 35)	31.53	(7, 34)	31.60	0.24	(9, 37)	32.70	3.72	3.48	
4	11	81	64	(63, 98)	49.46	(62, 99)	49.58	0.25	(67, 99)	50.94	2.99	2.74	
0	15	9	64	(10, 49)	42.70	(11, 49)	42.81	0.27	(11, 49)	42.78	0.20	-0.08	•
2	7	3	32	(14, 37)	19.79	(15, 36)	19.84	0.29	(15, 36)	19.84	0.29	0.0	
4	11	27	64	(58, 94)	45.41	(57, 94)	45.54	0.30	([illegible], 93)	46.08	1.49	1.19	
4	3	3	32	(10, 27)	13.61	(11, 26)	13.65	0.31	(12, 26)	13.84	1.68	1.37	
4	15	81	64	(84, 124)	57.53	(83, 125)	57.74	0.36	(89, 124)	59.15	2.81	2.45	
2	3	3	64	(3, 25)	17.59	(3, 23)	17.75	0.36	(4, 25)	17.80	0.65	0.28	
4	11	3	32	(47, 75)	25.94	(48, 74)	26.04	0.36	(48, 73)	26.10	0.59	0.23	
4	15	3	32	(65, 98)	30.28	(67, 97)	30.41	0.41	(67, 95)	30.47	0.60	0.20	
4	11	3	64	(43, 84)	34.73	(45, 82)	34.88	0.42	(44, 82)	34.79	0.16	-0.25	•
2	11	3	32	(24, 52)	24.76	(26, 51)	24.87	0.44	(26, 50)	24.93	0.66	0.22	
0	3	27	64	(2, 22)	20.69	(3, 22)	20.78	0.44	([illegible], 24)	22.16	7.11	6.67	
4	7	3	32	(28, 52)	20.74	(29, 50)	20.84	0.48	(30, 51)	20.92	0.89	0.40	
4	7	3	64	(25, 59)	27.74	(27, 57)	27.88	0.50	(27, 57)	27.88	0.50	0.0	
0	11	3	32	(3, 29)	23.45	(4, 27)	23.57	0.51	(3, 28)	23.45	0.00	-0.51	•
2	15	3	32	(35, 65)	28.89	(37, 66)	29.04	0.51	(36, 64)	28.93	0.14	-0.37	•
0	7	3	32	(0, 22)	18.73	(1, 20)	18.83	0.52	(1, 22)	18.76	0.16	-0.36	•
4	15	3	64	(61, 107)	40.52	(64, 106)	40.74	0.54	(62, 105)	40.58	0.15	-0.39	•
2	7	3	64	(12, 44)	27.00	(13, 42)	27.15	0.55	(12, 43)	27.01	0.05	-0.49	•
2	3	3	32	(4, 20)	12.98	(5, 19)	13.05	0.56	(6, 20)	13.22	1.90	1.34	
2	15	3	64	(31, 76)	39.43	(34, 74)	39.66	0.59	(32, 74)	39.48	0.12	-0.47	•
2	11	3	64	(21, 61)	33.80	(23, 58)	34.00	0.60	(22, 59)	33.85	0.16	-0.44	•
2	15	9	32	(43, 68)	33.89	(43, 72)	34.10	0.61	(44, 69)	33.99	0.29	-0.32	•
0	15	3	32	(5, 32)	27.20	(7, 34)	27.36	0.61	(6, 33)	27.22	0.08	-0.54	•
4	15	27	32	(81, 105)	41.42	(80, 110)	41.70	0.67	(83, 106)	41.75	0.81	0.13	
0	11	3	64	(0, 38)	32.92	(2, 35)	33.15	1.00	(0, 37)	32.82	0.02	-0.98	•
4	15	81	32	(86, 110)	45.77	(85, 115)	46.27	1.09	(89, 111)	46.47	1.53	0.44	
2	15	27	32	(48, 72)	38.01	(48, 77)	38.45	1.15	(51, 73)	38.53	1.35	0.20	
0	15	3	64	(2, 45)	38.25	(5, 42)	38.71	1.19	(1, 43)	38.32	0.18	-1.01	•
0	7	3	64	(-2, 29)	26.21	(0, 27)	26.53	1.23	(-1, 29)	26.27	0.25	-0.98	•
0	3	81	32	(4, 17)	16.49	(5, 18)	16.72	1.45	(7, 20)	18.33	11.25	9.81	
2	15	81	32	(53, 76)	41.56	(52, 81)	42.18	1.49	(56, 78)	42.63	2.58	1.09	
0	15	9	32	(12, 35)	30.67	(12, 39)	31.14	1.51	(13, 37)	30.97	0.98	-0.53	•
0	3	3	32	(-2, 13)	12.29	(0, 13)	12.53	2.01	(0, 14)	12.53	1.99	-0.02	•
0	3	3	64	(-3, 18)	17.17	(-1, 18)	17.52	2.08	(-2, 18)	17.27	0.59	-1.50	•
0	15	81	32	(18, 40)	35.68	(18, 45)	36.51	2.32	(22, 44)	37.81	5.95	3.63	
0	15	27	32	(15, 38)	33.40	(16, 43)	34.26	2.56	(18, 41)	34.52	3.35	0.79	

AVERAGE % ERROR IN TOTAL EXP.COST			0.35		2.53	
AVERAGE EXP.COST PER EACH CASE	30.80	30.91		31.56		
TOTAL EXP.COST PER EACH CASE	2957.09	2967.16		3030.05		
AVERAGE % ERROR DIFFERENCE MAD-ECM						2.18
SUMMARY-AVERAGE EXP.COST PER EACH CASE	24.67	24.93		25.41		
SUMMARY-TOTAL EXP.COST PER EACH CASE	4736.55	4787.50		4879.38		
TOTAL AVERAGE % ERROR IN TOTAL EXP.COST			1.26		3.29	
TOTAL AVERAGE % ERROR DIFFERENCE MAD-POW						2.03

COMPARISON OF OPT. POWER & NADDOR APPROXIMATIONS

VARIANCE-TO-MEAN RATIO = 3

*** ORDERED BY POWER APPROXIMATION ERROR ***

IN THIS TABLE SET-UP COSTS ARE: 8 AND 16

EXP.COST IS EXP. TOTAL COST

L	M	PI	K	OPTIMAL POLICY (S,S)	EXP.COST	POWER APPROXIMATION (S,S)	EXP.COST	ERROR	NADDOR APPROXIMATION (S,S)	EXP.COST	ERROR	COMPARISON NAD-POW	ND<PW
0	3	27	8	(6, 13)	12.93	(6, 13)	12.93	0.0	(7, 13)	13.09	1.24	1.24	
0	3	81	8	(9, 16)	15.81	(9, 16)	15.81	0.0	(9, 15)	15.85	0.25	0.25	
0	7	3	16	(2, 17)	14.73	(2, 17)	14.73	0.0	(4, 18)	15.08	2.34	2.34	
0	3	27	16	(5, 15)	15.09	(5, 15)	15.09	0.0	(6, 16)	15.22	0.86	0.86	
0	3	81	16	(8, 18)	17.98	(8, 18)	17.98	0.0	(8, 19)	18.02	0.21	0.21	
2	7	9	16	(23, 39)	23.51	(23, 39)	23.51	0.0	(26, 38)	24.04	2.24	2.24	
2	11	9	16	(36, 55)	29.13	(36, 55)	29.13	0.0	(39, 53)	29.71	1.98	1.98	
2	7	27	16	(29, 45)	28.81	(29, 45)	28.81	0.0	(3[illegible], 43)	29.11	1.03	1.03	
4	11	9	16	(61, 81)	33.66	(61, 81)	33.66	0.0	(64, 78)	34.39	2.16	2.16	
4	15	9	16	(82, 105)	39.03	(82, 105)	39.03	0.0	(85, 100)	39.93	2.31	2.31	
4	7	27	16	(47, 63)	33.49	(47, 63)	33.49	0.0	(48, 60)	33.89	1.18	1.18	
2	11	27	16	(43, 61)	35.46	(43, 62)	35.46	0.01	(45, 58)	35.93	1.32	1.32	
2	7	27	8	(31, 41)	25.65	(31, 42)	25.65	0.01	(32, 39)	26.01	1.43	1.41	
4	3	27	16	(23, 35)	22.81	(23, 34)	22.81	0.02	(24, 33)	23.01	0.89	0.87	
0	11	3	16	(5, 22)	18.42	(5, 23)	18.42	0.02	(7, 23)	18.69	1.46	1.44	
2	3	27	16	(14, 26)	19.68	(15, 26)	19.69	0.02	(16, 25)	19.88	1.02	1.00	
2	3	81	16	(19, 29)	23.49	(19, 30)	23.49	0.03	(18, 28)	23.57	0.35	0.31	
4	11	27	16	(70, 89)	41.29	(69, 89)	41.30	0.04	(72, 85)	41.99	1.71	1.67	
2	3	9	16	(10, 22)	15.75	(10, 21)	15.76	0.04	(13, 22)	16.35	3.83	3.79	
4	15	27	16	(92, 114)	47.72	(92, 115)	47.74	0.05	(94, 108)	48.58	1.80	1.75	
4	7	9	16	(39, 57)	27.15	(40, 56)	27.18	0.10	(42, 55)	27.57	1.55	1.44	
2	3	27	8	(15, 23)	17.69	(16, 24)	17.72	0.12	(17, 22)	18.06	2.05	1.93	
4	3	9	16	(18, 30)	18.20	(18, 29)	18.22	0.13	(20, 29)	18.60	2.21	2.08	
2	3	3	16	(5, 18)	11.88	(6, 17)	11.90	0.14	(8, 18)	12.25	3.10	2.95	
0	7	81	16	(14, 28)	25.76	(14, 29)	25.79	0.15	(15, 27)	25.83	0.30	0.15	
4	7	27	8	(48, 60)	30.50	(49, 61)	30.55	0.16	(50, 57)	31.03	1.75	1.59	
4	7	9	8	(41, 54)	24.29	(42, 54)	24.33	0.16	(44, 51)	24.99	2.88	2.71	
0	11	27	16	(15, 31)	27.26	(15, 33)	27.32	0.21	(17, 30)	27.56	1.09	0.88	
2	7	3	16	(16, 34)	18.04	(17, 33)	18.08	0.22	(20, 33)	18.66	3.44	3.22	
2	3	9	8	(11, 20)	13.83	(12, 20)	13.88	0.39	(14, 19)	14.48	4.70	4.32	
2	11	3	16	(27, 48)	22.50	(29, 48)	22.59	0.40	(31, 47)	23.00	2.21	1.81	
0	11	81	16	(20, 35)	31.40	(20, 38)	31.53	0.41	(20, 34)	31.44	0.13	-0.28	*
4	15	3	16	(69, 95)	29.79	(72, 95)	29.92	0.44	(75, 92)	30.74	3.21	2.77	
4	3	27	8	(24, 32)	20.92	(25, 33)	21.01	0.44	(25, 31)	21.13	0.99	0.55	
4	11	3	16	(50, 73)	25.61	(52, 72)	25.72	0.44	(55, 71)	26.36	2.94	2.50	
0	11	9	16	(10, 27)	22.91	(11, 29)	23.01	0.45	(12, 27)	23.09	0.80	0.35	
4	11	81	16	(78, 96)	48.33	(79, 99)	48.56	0.47	(78, 91)	49.00	1.37	0.91	
0	7	27	16	(10, 24)	22.16	(11, 26)	22.27	0.48	(12, 24)	22.40	1.10	0.62	
0	15	3	8	(10, 21)	16.37	(11, 20)	16.45	0.48	(13, 22)	16.71	2.09	1.61	
0	7	9	16	(6, 20)	18.45	(7, 22)	18.54	0.49	(8, 21)	18.69	1.32	0.82	
2	11	81	16	(50, 67)	41.33	(51, 70)	41.54	0.50	(50, 63)	41.79	1.10	0.60	
0	15	9	8	(16, 25)	21.01	(17, 24)	21.11	0.50	(18, 25)	21.12	0.54	0.04	
2	7	9	8	(25, 36)	20.47	(26, 37)	20.57	0.51	(27, 35)	20.83	1.75	1.24	
0	3	3	16	(-1, 10)	9.62	(0, 10)	9.67	0.52	(1, 11)	9.97	3.62	3.10	
4	7	81	16	(53, 69)	39.43	(55, 71)	39.64	0.53	(54, 65)	40.00	1.45	0.92	
4	3	9	8	(19, 28)	16.37	(20, 29)	16.47	0.56	(21, 27)	16.74	2.21	1.65	
4	3	81	16	(28, 39)	27.22	(29, 40)	27.39	0.61	(27, 37)	27.40	0.66	0.05	
4	7	3	16	(31, 50)	20.53	(32, 48)	20.66	0.63	(35, 49)	21.13	2.94	2.31	
2	7	81	16	(35, 50)	33.80	(36, 52)	34.02	0.64	(35, 47)	34.02	0.65	0.01	

4	3	3	16	(12, 25)	13.53	(13, 24)	13.63	0.74	(15, 25)	14.00	3.48	2.75	
4	15	81	16	(101, 122)	55.69	(103, 126)	56.12	0.76	(102, 115)	56.67	1.76	1.00	
4	7	3	8	(33, 47)	17.88	(35, 47)	18.02	0.78	(37, 46)	18.47	3.33	2.56	
0	3	9	16	(2, 12)	12.26	(3, 13)	12.36	0.83	(4, 14)	12.73	3.81	2.98	
2	7	3	8	(18, 31)	15.20	(20, 31)	15.34	0.97	(22, 30)	15.88	4.48	3.50	
2	3	3	8	(7, 16)	10.05	(8, 16)	10.15	0.98	(10, 16)	10.69	6.42	5.44	
0	3	3	8	(0, 8)	7.52	(1, 8)	7.59	1.04	(3, 9)	8.33	10.67	9.82	
4	3	3	8	(13, 23)	11.82	(15, 23)	11.98	1.28	(17, 23)	12.52	5.90	4.62	
2	3	81	8	(19, 27)	21.46	(21, 29)	21.76	1.43	(19, 25)	21.74	1.30	-0.13	*
2	7	81	8	(36, 46)	30.54	(38, 49)	30.98	1.45	(36, 43)	31.00	1.51	0.06	
0	3	9	8	(3, 10)	10.11	(4, 11)	10.27	1.63	(5, 11)	10.59	4.77	3.14	
2	15	9	8	(51, 64)	29.15	(52, 60)	29.63	1.64	(54, 61)	29.71	1.90	0.26	
2	15	27	8	(59, 71)	36.02	(59, 66)	36.74	1.98	(61, 67)	36.54	1.45	-0.53	*
4	15	9	8	(84, 100)	34.75	(85, 94)	35.46	2.04	(88, 96)	35.48	2.11	0.07	
4	3	81	8	(29, 37)	25.29	(31, 39)	25.82	2.11	(26, 34)	25.74	1.78	-0.33	*
0	11	3	8	(7, 19)	14.25	(7, 15)	14.55	2.14	(9, 18)	14.56	2.16	0.02	
4	15	27	8	(94, 108)	43.17	(95, 102)	44.11	2.18	(96, 103)	43.87	1.63	-0.55	*
0	15	27	8	(22, 30)	25.55	(22, 27)	26.19	2.48	(23, 28)	25.82	1.06	-1.42	*
4	7	81	8	(55, 66)	36.32	(58, 70)	37.25	2.54	(55, 62)	36.93	1.66	-0.87	*
2	15	3	8	(41, 57)	21.95	(44, 53)	22.55	2.77	(46, 55)	22.68	3.34	0.57	
4	15	81	8	(103, 116)	50.94	(107, 109)	52.53	3.13	(103, 110)	51.85	1.80	-1.33	*
2	11	9	8	(38, 51)	25.26	(39, 46)	26.08	3.25	(41, 48)	26.01	2.97	-0.27	*
0	11	9	8	(14, 22)	18.46	(12, 18)	19.11	3.51	(14, 21)	18.80	1.87	-1.65	*
4	15	3	8	(73, 91)	25.87	(76, 85)	26.82	3.66	(78, 87)	26.88	3.50	0.24	
4	11	9	8	(63, 77)	30.03	(64, 71)	31.24	4.02	(66, 74)	30.78	2.48	-1.55	*
2	11	3	8	(30, 44)	18.91	(32, 40)	19.69	4.09	(34, 43)	19.64	3.83	-0.26	*
4	11	27	8	(72, 85)	37.47	(72, 78)	39.00	4.10	(73, 81)	38.00	1.43	-2.67	*
2	15	81	8	(66, 77)	42.40	(69, 71)	44.18	4.20	(66, 72)	43.42	2.39	-1.81	*
2	11	27	8	(45, 57)	31.38	(46, 51)	32.79	4.49	(47, 53)	32.15	2.44	-2.04	*
4	11	3	8	(53, 69)	22.26	(56, 64)	23.31	4.70	(57, 67)	22.92	2.55	-1.75	*
0	7	3	8	(3, 13)	11.47	(4, 10)	12.08	5.35	(6, 14)	11.97	4.38	-0.97	*
0	15	3	16	(6, 27)	21.44	(8, 20)	22.60	5.39	(10, 27)	21.67	1.05	-4.34	*
0	15	9	16	(14, 33)	26.60	(15, 24)	28.06	5.47	(17, 31)	27.12	1.93	-3.54	*
0	7	9	8	(7, 17)	15.03	(8, 13)	15.89	5.75	(10, 17)	15.55	3.45	-2.30	*
0	11	27	8	(17, 26)	22.65	(17, 21)	24.03	6.07	(18, 24)	22.92	1.17	-4.90	*
4	11	81	8	(79, 92)	44.36	(83, 84)	47.11	6.20	(80, 86)	45.53	2.63	-3.56	*
2	15	9	16	(49, 70)	33.78	(49, 60)	35.93	6.38	(52, 66)	34.67	2.64	-3.74	*
0	15	81	8	(27, 34)	29.91	(27, 30)	31.92	6.75	(26, 31)	30.92	3.38	-3.36	*
2	15	27	16	(57, 77)	40.55	(57, 66)	43.75	6.84	(59, 73)	41.52	1.41	-5.43	*
2	15	3	16	(39, 62)	26.17	(40, 53)	28.01	7.03	(43, 60)	26.85	2.62	-4.41	*
0	15	27	16	(20, 38)	31.49	(20, 27)	33.71	7.03	(22, 35)	31.94	1.43	-5.60	*
2	11	81	8	(51, 63)	37.14	(54, 55)	40.22	8.23	(51, 58)	37.67	1.99	-6.30	*
2	15	81	16	(64, 84)	47.59	(65, 71)	51.74	8.73	(65, 78)	48.21	1.32	-7.41	*
0	11	81	8	(21, 33)	26.67	(22, 24)	29.32	9.91	(21, 27)	27.00	1.23	-8.68	*
0	15	81	16	(25, 42)	36.10	(25, 30)	39.73	10.08	(26, 39)	36.32	0.63	-9.45	*
0	7	27	8	(11, 21)	18.66	(12, 15)	20.65	11.75	(13, 20)	18.89	1.24	-10.52	*
0	7	81	8	(15, 24)	22.19	(16, 17)	27.02	21.76	(15, 22)	22.38	0.87	-20.88	*
AVERAGE % ERROR IN TOTAL EXP.COST								2.30			2.17		
AVERAGE EXP.COST PCB EACH CASE					25.88		26.53			26.38			
TOTAL EXP.COST PCB EACH CASE					2484.52		2547.33			2532.66			
AVERAGE % ERROR DIFFERENCE BAD-ECB												-0.14	

COMPARISON OF OPT. POWER & MADDCS APPROXIMATIONS

VARIANCE-TO-MEAN RATIO = 3

*** ORDERED BY POWER APPROXIMATION ERROR ***

IN THIS TABLE SET-UP COSTS ARE: 32 AND 64

EXP.COST IS EXP. TOTAL COST

L	M	PI	K	OPTIMAL POLICY (S,S)	OPTIMAL POLICY EXP.COST	POWER APPROXIMATION (S,S)	POWER APPROXIMATION EXP.COST	POWER APPROXIMATION ERROR	MADDCS APPROXIMATION (S,S)	MADDCS APPROXIMATION EXP.COST	MADDCS APPROXIMATION ERROR	COMPARISON MAD-POW	COMPARISON MD<PW
0	7	9	32	(5, 26)	23.56	(5, 26)	23.56	0.0	(7, 27)	23.92	1.52	1.52	
0	3	81	32	(7, 21)	21.31	(7, 21)	21.31	0.0	(8, 23)	21.45	0.63	0.63	
2	11	9	32	(34, 61)	35.05	(34, 61)	35.05	0.0	(36, 59)	35.36	0.87	0.87	
2	15	9	32	(46, 77)	40.72	(46, 77)	40.72	0.0	(49, 74)	41.19	1.15	1.15	
2	7	81	32	(33, 55)	38.75	(33, 55)	38.75	0.0	(34, 53)	38.83	0.19	0.19	
0	3	9	64	(0, 20)	20.44	(0, 20)	20.44	0.0	(2, 23)	20.84	1.95	1.95	
0	7	27	64	(8, 37)	35.08	(8, 37)	35.08	0.0	(11, 40)	35.95	2.48	2.48	
0	15	27	64	(17, 57)	50.74	(17, 57)	50.74	0.0	(20, 58)	51.45	1.41	1.41	
0	3	81	64	(6, 26)	26.28	(6, 26)	26.28	0.0	(9, 30)	27.24	3.66	3.66	
0	7	81	64	(12, 41)	38.81	(12, 41)	38.81	0.0	(15, 44)	39.75	2.43	2.43	
0	11	81	64	(17, 52)	48.00	(17, 52)	48.00	0.0	(21, 55)	49.24	2.57	2.57	
0	15	81	64	(22, 62)	55.59	(22, 62)	55.59	0.0	(26, 64)	56.72	2.03	2.03	
2	15	9	64	(43, 87)	51.19	(43, 87)	51.19	0.0	(46, 85)	51.55	0.71	0.71	
2	11	27	64	(40, 77)	50.82	(39, 77)	50.83	0.01	(42, 76)	51.17	0.69	0.68	
2	11	27	32	(42, 68)	41.61	(41, 68)	41.62	0.01	(4 , 65)	41.85	0.57	0.57	
0	11	9	32	(9, 33)	29.39	(9, 34)	29.40	0.01	(11, 34)	29.73	1.16	1.15	
0	15	3	32	(5, 35)	28.65	(5, 34)	28.65	0.02	(6, 35)	28.68	0.12	0.10	
0	3	9	32	(1, 16)	15.54	(1, 15)	15.55	0.02	(3, 16)	16.00	2.94	2.92	
0	7	27	32	(9, 29)	27.38	(9, 30)	27.38	0.02	(11, 31)	27.70	1.18	1.16	
0	3	3	64	(-3, 18)	17.57	(-3, 17)	17.57	0.02	(-1, 19)	17.97	2.29	2.28	
2	3	27	64	(12, 33)	27.37	(12, 34)	27.38	0.02	(14, 35)	27.67	1.07	1.05	
2	11	81	64	(47, 83)	57.04	(46, 84)	57.05	0.02	(48, 82)	57.19	0.27	0.24	
4	11	27	32	(68, 95)	47.15	(67, 95)	47.16	0.02	(70, 91)	47.75	1.27	1.24	
0	11	27	64	(13, 48)	43.67	(12, 47)	43.68	0.02	(15, 50)	44.21	1.22	1.20	
2	11	9	64	(31, 70)	43.97	(31, 69)	43.98	0.02	(34, 69)	44.30	0.75	0.72	
0	7	3	32	(0, 22)	19.63	(0, 21)	19.64	0.03	(1, 23)	19.72	0.46	0.44	
0	11	9	64	(7, 43)	38.95	(7, 42)	38.96	0.03	(9, 44)	39.23	0.72	0.69	
4	7	81	32	(52, 74)	44.16	(52, 75)	44.17	0.03	(52, 71)	44.36	0.46	0.43	
4	3	27	64	(20, 42)	30.22	(20, 43)	30.23	0.04	(22, 42)	30.42	0.65	0.61	
0	15	9	64	(10, 51)	45.41	(10, 50)	45.43	0.04	(12, 51)	45.54	0.27	0.23	
2	15	27	64	(53, 95)	59.01	(52, 96)	59.03	0.04	(55, 93)	59.33	0.56	0.51	
4	11	9	32	(58, 87)	39.26	(58, 86)	39.28	0.05	(61, 84)	39.74	1.22	1.17	
2	3	27	32	(13, 29)	22.74	(13, 28)	22.75	0.05	(15, 29)	22.94	0.87	0.82	
2	3	9	32	(9, 25)	18.73	(9, 24)	18.74	0.05	(11, 25)	19.04	1.67	1.62	
2	11	81	32	(48, 74)	47.63	(48, 75)	47.66	0.05	(49, 71)	47.79	0.32	0.27	
4	15	9	64	(76, 122)	55.64	(75, 120)	55.67	0.06	(79, 118)	56.15	0.93	0.87	
0	11	27	32	(14, 38)	33.89	(14, 39)	33.91	0.06	(16, 38)	34.24	1.05	0.99	
0	3	27	64	(3, 23)	23.35	(4, 24)	23.37	0.06	(6, 27)	24.29	4.01	3.95	
2	3	81	64	(17, 37)	31.31	(16, 38)	31.33	0.06	(17, 38)	31.32	0.03	-0.03	*
0	7	81	32	(13, 33)	31.04	(13, 34)	31.05	0.06	(15, 34)	31.39	1.16	1.10	
2	7	9	64	(19, 51)	35.24	(19, 50)	35.26	0.06	(22, 51)	35.57	0.94	0.88	
4	3	81	32	(27, 42)	30.23	(27, 43)	30.24	0.06	(27, 41)	30.26	0.13	0.07	
4	11	81	32	(76, 102)	54.37	(76, 104)	54.40	0.07	(76, 98)	54.69	0.60	0.53	
2	15	81	64	(61, 102)	66.03	(60, 104)	66.08	0.08	(63, 100)	66.42	0.60	0.52	
4	11	81	64	(74, 111)	63.46	(73, 113)	63.51	0.08	(75, 109)	63.63	0.26	0.19	
4	3	81	64	(25, 47)	34.79	(25, 48)	34.82	0.08	(26, 47)	34.81	0.06	-0.02	*
2	7	9	32	(21, 44)	28.18	(21, 43)	28.21	0.09	(24, 43)	28.57	1.39	1.30	
4	3	9	32	(16, 33)	21.02	(16, 32)	21.04	0.09	(19, 33)	21.48	2.15	2.06	
2	3	81	32	(18, 33)	26.60	(17, 32)	26.62	0.09	(18, 32)	26.60	0.02	-0.08	*

4	15	81	32	(99, 129)	62.79	(99, 131)	62.85	0.10	(100, 123)	63.38	0.94	0.84	
4	7	9	32	(37, 61)	31.58	(37, 60)	31.61	0.11	(40, 60)	31.93	1.11	1.00	
4	15	9	32	(79, 112)	45.61	(78, 110)	45.66	0.11	(82, 107)	46.25	1.40	1.29	
2	15	27	32	(55, 84)	48.17	(54, 85)	48.23	0.12	(57, 81)	48.55	0.80	0.68	
0	7	9	64	(4, 33)	31.15	(3, 32)	31.19	0.12	(5, 35)	31.34	0.63	0.50	
2	15	81	32	(63, 91)	54.97	(62, 93)	55.04	0.12	(63, 87)	55.22	0.46	0.33	
0	15	9	32	(13, 40)	34.18	(13, 42)	34.23	0.13	(14, 40)	34.30	0.33	0.21	
2	3	9	64	(8, 29)	23.27	(7, 29)	23.30	0.13	(10, 30)	23.68	1.76	1.62	
4	3	3	64	(8, 32)	20.31	(8, 31)	20.33	0.14	(11, 33)	20.63	1.60	1.47	
4	3	27	32	(22, 38)	25.74	(21, 37)	25.78	0.14	(23, 37)	25.88	0.55	0.41	
2	15	3	32	(35, 69)	32.65	(36, 67)	32.69	0.14	(39, 67)	33.07	1.29	1.15	
0	11	81	32	(13, 42)	38.14	(19, 44)	38.19	0.14	(20, 43)	38.33	0.50	0.35	
4	11	27	64	(65, 104)	56.02	(64, 104)	56.10	0.14	(67, 101)	56.28	0.46	0.31	
0	11	3	32	(2, 29)	24.59	(2, 27)	24.63	0.15	(4, 29)	24.70	0.46	0.31	
2	7	27	32	(28, 50)	33.64	(27, 49)	33.69	0.15	(29, 48)	33.80	0.46	0.31	
4	3	9	64	(15, 37)	25.37	(14, 37)	25.41	0.16	(17, 38)	25.67	1.20	1.04	
2	15	3	64	(31, 78)	42.45	(32, 76)	42.52	0.18	(33, 76)	42.60	0.36	0.17	
4	15	81	64	(97, 140)	73.50	(95, 140)	73.64	0.19	(98, 136)	73.72	0.30	0.11	
2	7	81	64	(32, 62)	46.14	(31, 62)	46.23	0.19	(33, 62)	46.22	0.18	-0.01	*
0	7	3	64	(-2, 29)	26.87	(-2, 27)	26.92	0.19	(-1, 30)	26.96	0.37	0.17	
4	7	81	64	(50, 81)	51.33	(49, 81)	51.43	0.20	(51, 80)	51.40	0.13	-0.06	*
4	11	9	64	(55, 96)	47.80	(54, 94)	47.91	0.22	(58, 93)	48.15	0.72	0.51	
2	11	3	32	(24, 54)	28.03	(25, 52)	28.03	0.22	(28, 53)	28.44	1.45	1.23	
4	15	27	32	(50, 121)	54.61	(88, 120)	54.74	0.23	(92, 116)	55.17	1.02	0.79	
4	7	27	64	(43, 75)	45.11	(42, 74)	45.22	0.24	(45, 74)	45.32	0.45	0.21	
4	7	27	32	(45, 68)	38.10	(44, 67)	38.20	0.24	(47, 66)	38.41	0.80	0.56	
0	15	27	32	(19, 45)	39.27	(19, 48)	39.37	0.25	(21, 45)	39.72	1.14	0.88	
0	15	81	32	(24, 50)	43.96	(24, 53)	44.09	0.28	(26, 49)	44.44	1.07	0.79	
2	7	27	64	(26, 57)	40.91	(25, 56)	41.02	0.29	(28, 57)	41.13	0.55	0.27	
0	15	3	64	(1, 45)	39.27	(2, 42)	39.38	0.29	(2, 45)	39.27	0.01	-0.28	*
0	11	3	64	(-1, 38)	33.65	(0, 35)	33.75	0.29	(0, 36)	33.67	0.04	-0.25	*
4	15	27	64	(87, 131)	65.04	(85, 130)	65.24	0.30	(89, 127)	65.39	0.54	0.24	
0	3	27	32	(4, 18)	18.41	(5, 19)	18.46	0.30	(6, 21)	18.90	2.68	2.38	
4	15	3	32	(66, 102)	35.87	(67, 99)	35.99	0.32	(70, 98)	36.46	1.63	1.31	
2	11	3	64	(21, 62)	36.39	(21, 59)	36.52	0.35	(23, 61)	36.54	0.40	0.05	
4	7	9	64	(35, 68)	38.32	(34, 66)	38.46	0.35	(38, 67)	38.72	1.03	0.68	
4	11	3	64	(43, 87)	38.75	(43, 83)	38.90	0.37	(46, 84)	39.05	0.75	0.38	
4	15	3	64	(61, 111)	45.19	(62, 107)	45.36	0.38	(65, 108)	45.58	0.87	0.49	
0	3	3	32	(-2, 13)	12.82	(-1, 13)	12.87	0.39	(0, 15)	13.22	3.12	2.73	
4	11	3	32	(47, 75)	30.80	(48, 76)	30.92	0.39	(51, 76)	31.34	1.75	1.36	
4	7	3	32	(28, 54)	24.65	(29, 52)	24.76	0.45	(32, 53)	25.12	1.91	1.46	
2	7	3	32	(14, 38)	22.42	(14, 36)	22.52	0.45	(17, 38)	22.78	1.61	1.16	
2	7	3	64	(11, 45)	29.06	(11, 42)	29.19	0.45	(13, 45)	29.18	0.40	-0.05	*
2	3	3	32	(4, 21)	14.70	(4, 19)	14.77	0.46	(7, 22)	15.23	3.60	3.13	
4	3	3	32	(10, 28)	16.20	(10, 26)	16.30	0.60	(13, 28)	16.55	2.17	1.56	
4	7	3	64	(25, 61)	30.96	(25, 57)	31.17	0.67	(28, 60)	31.20	0.75	0.08	
2	3	3	64	(2, 25)	19.03	(1, 23)	19.19	0.88	(4, 26)	19.20	0.91	0.02	

AVERAGE % ERROR IN TOTAL EXP.COST			0.15		1.07	
AVERAGE EXP.COST FOR EACH CASE	36.82	36.87		37.16		
TOTAL EXP.COST FOR EACH CASE	3534.39	3539.24		3567.32		
AVERAGE % ERROR DIFFERENCE MAD-ECM						0.92
SUMMARY-AVERAGE EXP.COST FOR EACH CASE	6019.30	6086.57		6099.57		
SUMMARY-TOTAL EXP.COST FOR EACH CASE	31.35	31.70		31.77		
TOTAL AVERAGE % ERROR IN TOTAL EXP.COST			1.23		1.62	
TOTAL AVERAGE % ERROR DIFFERENCE MAD-ECM						0.39

COMPARISON OF OPT. POWER & NADDOR APPROXIMATIONS

VARIANCE-TO-MEAN RATIO = 5

*** ORDERED BY POWER APPROXIMATION ERROR ***

IN THIS TABLE SET-UP COSTS ARE: 8 AND 16

EXP.COST IS EXP. TOTAL COST

L	M	PI	K	OPTIMAL POLICY (S,S)	EXP.COST	POWER APPROXIMATION (S,S)	EXP.COST	ERROR	NADDOR APPROXIMATION (S,S)	EXP.COST	ERROR	COMPARISON NAD-POW	ND<PW
0	7	81	16	(25, 41)	42.31	(25, 41)	42.31	0.0	(21, 36)	43.97	3.92	3.92	
2	3	27	16	(24, 35)	33.13	(23, 35)	33.13	0.02	(22, 33)	33.23	0.30	0.28	
0	7	27	16	(17, 32)	33.41	(17, 33)	33.41	0.02	(17, 31)	33.45	0.12	0.10	
0	11	81	16	(33, 51)	49.93	(33, 52)	49.95	0.03	(28, 43)	52.59	5.33	5.30	
0	7	81	8	(27, 39)	39.65	(28, 39)	39.67	0.05	(22, 30)	43.55	9.82	9.77	
2	7	27	16	(41, 59)	46.60	(42, 59)	46.65	0.10	(40, 54)	47.02	0.89	0.79	
2	3	81	16	(32, 44)	42.45	(33, 45)	42.51	0.13	(26, 38)	45.11	6.25	6.13	
0	3	81	8	(18, 26)	29.76	(17, 25)	29.81	0.18	(1 , 21)	31.88	7.15	6.97	
0	11	27	16	(23, 41)	40.21	(24, 43)	40.29	0.20	(23, 39)	40.44	0.57	0.36	
2	11	27	16	(57, 78)	56.24	(59, 80)	56.37	0.23	(57, 71)	57.21	1.73	1.50	
0	3	27	16	(9, 20)	23.55	(10, 21)	23.60	0.23	(10, 22)	23.67	0.50	0.27	
4	3	27	16	(33, 46)	39.18	(35, 47)	39.28	0.26	(33, 43)	39.46	0.71	0.45	
2	15	27	16	(73, 96)	64.15	(75, 99)	64.35	0.32	(73, 88)	65.28	1.76	1.44	
4	7	27	16	(61, 80)	55.40	(64, 82)	55.57	0.32	(61, 74)	56.19	1.43	1.11	
4	15	9	16	(95, 120)	59.93	(97, 121)	60.16	0.37	([illegible], 114)	61.13	2.00	1.62	
4	15	27	16	(112, 138)	76.77	(116, 140)	77.05	0.37	(113, 128)	78.22	1.89	1.52	
2	7	9	16	(29, 47)	35.38	(31, 48)	35.52	0.41	(33, 46)	35.89	1.45	1.04	
4	11	9	16	(70, 94)	52.01	(74, 95)	52.22	0.41	(76, 90)	52.96	1.83	1.42	
0	7	27	8	(18, 30)	30.75	(20, 31)	30.88	0.42	(18, 26)	31.17	1.37	0.95	
4	11	27	16	(87, 110)	67.12	(91, 112)	67.41	0.43	(88, 102)	68.24	1.68	1.25	
2	7	81	16	(52, 70)	57.81	(55, 72)	58.07	0.45	(47, 60)	61.20	5.85	5.40	
0	7	3	16	(1, 16)	17.50	(2, 18)	17.58	0.46	(6, 20)	18.58	6.17	5.71	
2	3	27	8	(24, 33)	31.66	([illegible], 34)	31.81	0.47	(23, 30)	31.99	1.04	0.56	
2	15	9	16	(57, 82)	49.95	([illegible], 84)	50.19	0.48	(62, 77)	50.86	1.82	1.34	
2	11	9	16	(43, 65)	43.39	(46, 67)	43.63	0.54	(47, 62)	43.94	1.26	0.71	
0	11	9	16	(13, 32)	30.75	([illegible], 34)	30.92	0.56	(17, 32)	31.19	1.45	0.89	
0	3	81	16	(16, 28)	31.31	(15, [illegible])	31.49	0.59	(12, 25)	32.57	4.04	3.45	
4	3	9	16	(22, 36)	28.98	(25, 37)	29.16	0.62	(26, 36)	29.31	1.15	0.53	
2	3	81	8	(33, 43)	40.99	(36, 44)	41.25	0.65	(27, 34)	45.26	10.42	9.77	
0	11	3	16	(4, 23)	22.09	(6, 25)	22.25	0.74	(9, 26)	22.88	3.61	2.86	
4	3	81	16	(44, 57)	49.53	(47, 59)	49.90	0.75	(38, 49)	52.51	6.01	5.26	
0	3	27	8	(10, 19)	21.98	(12, 20)	22.15	0.79	(11, 18)	22.01	0.12	-0.67	•
0	7	9	16	(8, 24)	24.94	(10, 26)	25.13	0.79	(12, 26)	25.51	2.31	1.52	
2	7	27	8	(43, 56)	44.16	(46, 58)	44.51	0.79	(42, 50)	45.00	1.90	1.11	
4	7	9	16	(47, 67)	42.36	(51, 69)	42.71	0.82	(52, 65)	42.97	1.45	0.63	
2	7	3	16	(17, 36)	24.71	(20, 37)	24.96	0.98	(23, 37)	25.56	3.41	2.43	
2	15	3	16	(40, 67)	35.91	(45, 69)	36.30	1.11	(48, 66)	36.90	2.78	1.67	
2	11	81	16	(71, 91)	68.86	(75, 96)	69.66	1.16	(65, 80)	72.33	5.04	3.88	
2	3	9	16	(13, 26)	24.14	(16, 29)	24.44	1.24	(17, 27)	24.57	1.77	0.54	
0	15	3	8	(10, 25)	21.75	(13, 23)	22.04	1.31	(16, 25)	22.49	3.39	2.07	
2	11	3	16	(28, 52)	30.87	(33, 54)	31.28	1.33	(36, 52)	31.90	3.34	2.01	
4	7	27	8	(64, 78)	53.07	(65, 81)	53.81	1.39	(63, 71)	54.05	1.84	0.45	
2	15	81	16	(88, 110)	77.94	(93, 117)	79.11	1.50	(82, 97)	82.17	5.42	3.93	
0	11	3	8	(6, 20)	18.68	(9, 18)	18.96	1.52	(12, 21)	19.50	4.42	2.50	
2	7	9	8	(31, 44)	32.99	(35, 47)	33.50	1.55	(35, 42)	33.59	1.81	0.27	
4	15	3	16	(72, 102)	42.98	(80, 104)	43.67	1.60	(82, 99)	44.33	3.15	1.55	
2	3	9	8	(15, 24)	22.68	(18, 26)	23.04	1.61	(18, 25)	22.98	1.36	-0.25	•
4	11	3	16	(52, 78)	36.58	(59, 80)	37.58	1.63	(61, 77)	38.11	3.05	1.42	
4	7	9	8	(49, 64)	40.11	(55, 67)	40.77	1.66	(54, 61)	40.80	1.73	0.08	

4	3	27	8	(35, 45)	37.78	(39, 48)	38.46	1.81	(34, 40)	38.38	1.61	-0.21	*
4	3	3	16	(12, 26)	19.49	(16, 28)	15.87	1.95	(18, 29)	20.36	4.45	2.49	
4	7	3	16	(32, 54)	29.66	(38, 56)	30.24	1.96	(40, 54)	30.66	3.37	1.41	
0	7	3	8	(3, 14)	14.81	(5, 16)	15.10	1.99	(8, 17)	15.89	7.30	5.32	
2	3	3	16	(5, 18)	16.06	(8, 20)	16.40	2.12	(11, 21)	17.21	7.13	5.01	
0	7	9	8	(10, 21)	22.27	(13, 24)	22.74	2.12	(13, 22)	22.58	1.42	-0.70	*
4	7	81	16	(75, 94)	68.18	(82, 100)	69.78	2.35	(70, 83)	71.29	4.56	2.21	
0	3	9	16	(3, 13)	16.54	(5, 16)	16.95	2.45	(7, 18)	17.79	7.55	5.10	
0	15	9	8	(21, 35)	31.27	(23, 30)	32.06	2.52	(24, 32)	31.77	1.59	-0.93	*
4	11	81	16	(103, 125)	81.71	(112, 133)	83.88	2.65	(98, 112)	85.60	4.76	2.11	
2	7	81	8	(54, 67)	55.34	(61, 73)	56.53	2.87	(48, 56)	60.40	9.14	6.27	
4	15	81	16	(130, 154)	92.87	(140, 164)	95.53	2.87	(125, 140)	96.82	4.26	1.39	
0	15	3	16	(7, 29)	25.79	(5, 23)	26.54	2.89	(13, 31)	26.60	3.13	0.23	
4	3	9	8	(24, 34)	27.58	(29, 38)	28.42	3.05	(27, 34)	27.81	0.80	-2.24	*
2	15	9	8	(60, 77)	46.28	(65, 71)	47.70	3.06	(64, 72)	47.20	1.99	-1.07	*
0	11	9	8	(15, 28)	27.29	(18, 24)	28.17	3.25	(19, 27)	27.73	1.64	-1.61	*
2	15	3	8	(44, 63)	32.45	(51, 59)	33.56	3.42	(51, 61)	33.31	2.64	-0.78	*
4	15	9	8	(97, 116)	56.49	(103, 108)	58.42	3.42	(102, 110)	57.59	1.95	-1.48	*
0	3	3	16	(-1, 8)	10.96	(0, 11)	11.34	3.43	(2, 13)	12.26	11.80	8.37	
4	3	81	8	(45, 55)	48.11	(52, 61)	49.83	3.57	(39, 46)	52.18	8.46	4.89	
2	7	3	8	(19, 33)	22.41	(25, 37)	23.30	3.96	(25, 34)	23.12	3.17	-0.79	*
2	11	9	8	(46, 61)	40.31	(50, 55)	41.92	3.97	(50, 58)	41.01	1.73	-2.24	*
2	11	3	8	(31, 48)	27.94	(38, 45)	29.05	3.98	(38, 48)	28.69	2.67	-1.31	*
4	11	9	8	(73, 91)	49.10	(80, 84)	51.18	4.24	(78, 86)	49.97	1.76	-2.47	*
4	7	3	8	(35, 51)	27.52	(43, 55)	28.71	4.32	(42, 51)	28.32	2.92	-1.40	*
4	15	3	8	(76, 98)	39.76	(87, 93)	41.63	4.71	(85, 95)	40.81	2.63	-2.08	*
0	3	9	8	(4, 12)	14.90	(7, 15)	15.61	4.75	(8, 15)	15.86	6.43	1.68	
2	3	3	8	(7, 16)	14.62	(11, 19)	15.32	4.79	(12, 19)	15.55	6.41	1.62	
4	15	27	8	(115, 133)	73.17	(121, 122)	76.92	5.13	(116, 123)	75.36	2.99	-2.14	*
0	15	9	16	(18, 39)	35.42	(20, 30)	37.32	5.35	(22, 38)	35.88	1.29	-4.06	*
4	11	3	8	(56, 75)	34.25	(65, 70)	36.17	5.61	(64, 73)	35.29	3.04	-2.57	*
4	7	81	8	(77, 91)	65.81	(89, 101)	69.77	6.02	(71, 79)	70.40	6.98	0.96	
4	3	3	8	(14, 24)	18.14	(20, 29)	19.28	6.29	(20, 27)	19.03	4.94	-1.35	*
2	15	27	8	(76, 92)	60.35	(80, 81)	64.27	6.49	(75, 82)	62.71	3.92	-2.58	*
4	11	27	8	(90, 106)	64.10	(94, 95)	68.59	7.01	(90, 98)	65.58	2.31	-4.69	*
0	15	27	8	(31, 45)	41.49	(33, 36)	44.65	7.63	(31, 37)	43.60	5.10	-2.53	*
2	11	27	8	(60, 75)	53.07	(63, 64)	57.51	8.37	(59, 67)	54.47	2.64	-5.73	*
0	3	3	8	(-1, 6)	9.21	(2, 10)	9.99	8.49	(4, 11)	10.81	17.36	8.87	
0	11	27	8	(25, 38)	36.72	(26, 29)	40.11	9.25	(25, 32)	37.85	3.09	-6.15	*
4	15	81	8	(133, 150)	89.16	(132, 133)	97.42	9.26	(128, 134)	95.73	7.36	-1.89	*
0	15	27	16	(29, 49)	45.70	(29, 36)	50.53	10.57	(29, 44)	46.17	1.03	-9.54	*
4	11	81	8	(106, 121)	78.62	(104, 105)	87.58	11.39	(100, 108)	83.64	6.39	-5.01	*
2	15	81	8	(90, 106)	74.04	(89, 90)	82.57	12.05	(85, 91)	81.22	9.69	-2.36	*
2	11	81	8	(73, 86)	65.62	(71, 72)	75.02	14.33	(67, 74)	71.68	9.53	-4.79	*
0	15	81	8	(42, 55)	51.85	(40, 41)	62.29	20.13	(36, 42)	60.42	16.53	-3.61	*
0	15	81	16	(40, 59)	56.11	(40, 41)	70.16	25.04	(35, 50)	58.97	5.10	-19.94	*
0	11	81	8	(35, 48)	46.42	(32, 33)	58.38	25.77	(29, 37)	52.01	12.03	-13.73	*
AVERAGE % ERROR IN TOTAL EXP.COST								3.40			3.96		
AVERAGE EXP.COST FOR EACH CASE					41.50		43.10			43.16			
TOTAL EXP.COST FOR EACH CASE					3963.71		4137.58			4143.46			
AVERAGE % ERROR DIFFERENCE BAD-ECM												0.56	

COMPARISON OF OPT. POWER & NADDOR APPROXIMATIONS

VARIANCE-TO-MEAN RATIO = 9

*** ORDERED BY POWER APPROXIMATION ERROR ***

IN THIS TABLE SET-UP COSTS ARE: 32 AND 64

EXP.COST IS EXP. TOTAL COST

L	R	PI	K	OPTIMAL POLICY (S,S)	OPTIMAL POLICY EXP.COST	POWER APPROXIMATION (S,S)	POWER APPROXIMATION EXP.COST	POWER APPROXIMATION ERROR	NADDOR APPROXIMATION (S,S)	NADDOR APPROXIMATION EXP.COST	NADDOR APPROXIMATION ERROR	COMPARISON NAD-POW ND<PW
0	15	3	32	(4, 35)	32.15	(4, 35)	32.15	0.0	(9, 38)	32.81	2.03	2.03
0	3	27	32	(8, 23)	26.11	(8, 23)	26.11	0.0	(9, 26)	26.39	1.06	1.06
0	7	27	32	(15, 37)	37.65	(15, 37)	37.65	0.0	(15, 38)	37.68	0.08	0.08
2	3	27	32	(21, 38)	35.49	(21, 38)	35.49	0.0	(21, 37)	35.50	0.02	0.02
2	15	27	32	(70, 103)	70.18	(70, 103)	70.18	0.0	(70, 96)	70.72	0.78	0.78
0	7	9	64	(4, 35)	35.83	(4, 35)	35.83	0.0	(8, 40)	36.71	2.45	2.45
0	11	9	64	(8, 46)	44.73	(8, 46)	44.73	0.0	(12, 50)	45.39	1.49	1.49
2	3	9	64	(10, 33)	30.25	(10, 33)	30.25	0.0	(14, 36)	31.02	2.56	2.56
4	3	27	64	(29, 53)	45.08	(29, 53)	45.08	0.0	(29, 52)	45.10	0.06	0.06
4	7	81	64	(70, 104)	77.94	(70, 105)	77.94	0.00	(65, 97)	79.43	1.91	1.91
2	7	81	64	(48, 81)	67.56	(47, 81)	67.57	0.01	(44, 76)	68.75	1.16	1.15
0	11	27	64	(18, 55)	54.30	(18, 56)	54.30	0.01	(20, 58)	54.50	0.38	0.37
2	11	27	32	(54, 84)	61.29	(54, 83)	61.30	0.01	(55, 78)	61.77	0.78	0.77
0	11	3	32	(2, 29)	27.50	(1, 28)	27.51	0.01	(6, 32)	28.24	2.68	2.67
2	7	9	64	(23, 58)	45.18	(23, 57)	45.19	0.01	(27, 59)	45.56	0.84	0.83
0	7	27	64	(13, 43)	44.27	(13, 44)	44.27	0.01	(14, 47)	44.52	0.56	0.55
4	3	9	64	(18, 43)	34.79	(19, 43)	34.79	0.02	(22, 45)	35.22	1.23	1.22
0	15	9	64	(12, 55)	52.01	(12, 56)	52.02	0.02	(16, 58)	52.54	1.01	0.99
0	11	81	32	(31, 57)	55.51	(30, 57)	55.51	0.02	(27, 53)	56.31	1.45	1.43
2	7	27	32	(38, 63)	50.50	(38, 62)	50.51	0.02	(38, 59)	50.73	0.46	0.44
4	11	27	64	(81, 124)	79.42	(80, 123)	79.44	0.02	(82, 119)	79.81	0.49	0.47
2	15	81	64	(81, 126)	93.63	(81, 128)	93.65	0.02	(78, 119)	94.48	0.91	0.89
4	11	27	32	(84, 116)	71.91	(85, 115)	71.93	0.02	(85, 108)	72.71	1.11	1.09
2	7	27	64	(36, 69)	56.61	(35, 69)	56.62	0.02	(36, 68)	56.63	0.03	0.01
2	15	27	64	(66, 112)	79.51	(65, 112)	79.53	0.02	(67, 108)	79.72	0.26	0.23
2	11	81	64	(65, 105)	82.01	(64, 105)	82.03	0.02	(61, 99)	82.90	1.08	1.05
0	15	3	64	(1, 45)	41.92	(0, 44)	41.93	0.02	(3, 48)	42.14	0.54	0.52
2	3	3	64	(1, 25)	22.15	(1, 24)	22.16	0.02	(6, 29)	23.09	4.24	4.22
2	15	9	64	(49, 97)	64.81	(49, 96)	64.83	0.03	(54, 95)	65.35	0.83	0.81
4	3	27	32	(31, 49)	41.46	(32, 49)	41.47	0.03	(31, 47)	41.55	0.22	0.20
0	15	27	64	(23, 66)	62.53	(23, 67)	62.55	0.03	(25, 67)	62.64	0.16	0.14
2	15	9	32	(53, 88)	55.77	(54, 87)	55.78	0.03	(58, 85)	56.34	1.03	1.00
2	3	3	32	(3, 21)	18.42	(4, 21)	18.43	0.03	(9, 25)	19.66	6.73	6.70
2	11	9	64	(36, 79)	55.95	(36, 77)	55.97	0.04	(41, 78)	56.45	0.89	0.85
4	15	27	32	(109, 144)	82.47	(110, 145)	82.50	0.04	(110, 135)	83.53	1.29	1.25
0	11	27	32	(21, 47)	45.75	(21, 48)	45.77	0.04	(21, 46)	45.76	0.02	-0.02
2	7	9	32	(26, 51)	39.19	(27, 51)	39.21	0.04	(30, 51)	39.58	1.00	0.95
2	7	81	32	(50, 74)	61.76	(51, 75)	61.79	0.05	(45, 67)	63.71	3.15	3.10
4	7	27	32	(59, 85)	59.11	(60, 85)	59.14	0.05	(59, 80)	59.46	0.60	0.54
2	11	9	32	(40, 70)	48.29	(41, 70)	48.32	0.05	(44, 69)	48.71	0.86	0.81
0	15	27	32	(26, 55)	52.35	(26, 57)	52.38	0.06	(27, 54)	52.39	0.07	0.02
4	11	9	64	(63, 108)	63.87	(63, 106)	63.90	0.06	(68, 105)	64.45	0.91	0.85
2	11	27	64	(51, 92)	69.16	(50, 91)	69.20	0.06	(52, 89)	69.27	0.16	0.10
4	3	81	32	(42, 60)	51.83	(43, 60)	51.86	0.06	(37, 53)	53.84	3.87	3.81
4	7	27	64	(56, 91)	64.96	(55, 90)	65.00	0.06	(56, 87)	65.18	0.34	0.28
4	7	9	64	(41, 78)	51.65	(41, 76)	51.68	0.06	(46, 77)	52.19	1.06	0.99
4	3	3	64	(8, 33)	25.15	(8, 32)	25.17	0.07	(14, 36)	26.20	4.17	4.10
4	3	81	64	(40, 64)	55.48	(39, 63)	55.52	0.08	(35, 59)	56.94	2.63	2.55
0	7	9	32	(6, 28)	29.20	(7, 29)	29.22	0.08	(10, 32)	29.92	2.47	2.40

4	11	81	64	(97, 139)	94.31	(98, 141)	94.39	0.08	(93, 129)	95.81	1.59	1.51
4	15	81	64	(123, 170)	107.86	(124, 173)	107.55	0.08	(119, 159)	109.49	1.51	1.43
2	11	81	32	(68, 97)	74.01	(69, 98)	74.07	0.08	(63, 87)	76.20	2.97	2.89
4	15	9	32	(89, 127)	65.40	(91, 126)	65.45	0.08	(95, 121)	66.38	1.51	1.43
0	11	81	64	(28, 65)	64.08	(27, 65)	64.14	0.09	(26, 66)	64.29	0.33	0.24
4	15	27	64	(105, 154)	91.36	(103, 152)	91.45	0.09	(106, 146)	91.96	0.65	0.56
0	15	81	32	(37, 66)	62.81	(36, 67)	62.87	0.10	(33, 61)	63.91	1.74	1.64
2	3	27	64	(19, 42)	39.26	(18, 41)	39.29	0.10	(19, 43)	39.28	0.06	-0.04
0	15	81	64	(34, 76)	73.07	(33, 77)	73.15	0.11	(33, 76)	73.14	0.10	-0.01
4	15	9	64	(85, 136)	73.95	(84, 133)	74.03	0.11	(90, 131)	74.70	1.02	0.91
4	7	9	32	(44, 71)	45.97	(46, 71)	46.03	0.12	(49, 69)	46.56	1.28	1.16
0	15	9	32	(15, 45)	41.97	(16, 47)	42.03	0.14	(19, 46)	42.40	1.04	0.89
4	11	9	32	(67, 100)	56.62	(65, 99)	56.70	0.15	(72, 96)	57.32	1.24	1.10
2	3	81	32	(30, 47)	44.82	(29, 46)	44.90	0.16	(25, 42)	46.67	4.11	3.95
4	3	9	32	(21, 39)	31.22	(22, 39)	31.27	0.17	(25, 40)	31.77	1.76	1.59
2	3	81	64	(28, 51)	48.59	(27, 50)	48.68	0.18	(24, 49)	49.53	1.92	1.74
2	7	3	32	(14, 40)	28.38	(15, 33)	28.44	0.18	(20, 42)	29.21	2.93	2.74
0	7	81	64	(21, 52)	53.14	(20, 51)	53.25	0.20	(19, 54)	53.45	0.58	0.38
2	7	3	64	(11, 47)	34.15	(10, 44)	34.23	0.23	(16, 49)	34.84	2.02	1.79
0	11	9	32	(11, 37)	36.24	(12, 39)	36.32	0.23	(14, 39)	36.61	1.03	0.80
0	7	3	32	(-1, 21)	21.79	(0, 22)	21.84	0.23	(3, 25)	22.63	3.85	3.62
0	3	81	64	(13, 35)	37.80	(12, 34)	37.89	0.24	(11, 38)	38.22	1.10	0.87
4	7	81	32	(73, 98)	71.98	(75, 100)	72.18	0.28	(68, 88)	74.32	3.26	2.97
0	7	81	32	(24, 46)	46.55	(22, 44)	46.68	0.29	(20, 43)	47.28	1.56	1.27
0	11	3	64	(-1, 37)	35.85	(-3, 35)	35.95	0.29	(1, 41)	36.19	0.96	0.67
2	15	3	32	(36, 73)	41.39	(38, 71)	41.51	0.30	(43, 72)	42.22	2.00	1.70
4	7	3	64	(25, 64)	38.48	(26, 61)	38.60	0.30	(32, 65)	39.25	1.98	1.68
2	15	81	32	(85, 117)	84.10	(87, 120)	84.36	0.31	(80, 106)	86.28	2.60	2.29
2	15	3	64	(31, 82)	49.94	(31, 78)	50.10	0.32	(37, 82)	50.53	1.17	0.85
2	11	3	32	(25, 57)	35.53	(27, 56)	35.64	0.32	(32, 58)	36.46	2.61	2.29
4	11	3	64	(44, 92)	48.14	(45, 88)	48.29	0.32	(52, 91)	49.16	2.12	1.80
2	3	9	32	(12, 29)	26.50	(13, 30)	26.59	0.33	(15, 31)	26.96	1.71	1.38
0	3	27	64	(6, 27)	30.15	(7, 29)	30.26	0.36	(8, 33)	30.89	2.42	2.06
4	3	3	32	(10, 29)	21.67	(12, 29)	21.76	0.38	(16, 32)	22.59	4.24	3.86
4	15	3	64	(62, 118)	56.09	(64, 113)	56.31	0.38	(71, 115)	57.16	1.90	1.52
2	11	3	64	(21, 65)	42.82	(20, 61)	42.99	0.40	(27, 66)	43.56	1.73	1.33
4	7	3	32	(29, 58)	33.09	(32, 57)	33.24	0.47	(37, 58)	34.17	3.26	2.79
4	11	81	32	(100, 131)	86.63	(104, 134)	87.07	0.51	(96, 119)	89.06	2.81	2.30
4	15	3	32	(68, 109)	48.09	(72, 107)	48.33	0.51	(77, 106)	49.27	2.46	1.95
4	11	3	32	(46, 84)	41.32	(52, 82)	41.55	0.56	(57, 83)	42.41	2.64	2.08
0	7	3	64	(-3, 27)	28.47	(-5, 26)	28.66	0.64	(0, 33)	29.18	2.48	1.84
0	3	9	64	(0, 20)	23.37	(1, 23)	23.53	0.68	(4, 28)	25.02	7.05	6.37
0	3	3	32	(-2, 11)	13.85	(-2, 13)	13.95	0.73	(1, 17)	15.30	10.52	9.79
0	3	3	64	(-4, 15)	18.32	(-5, 17)	18.46	0.77	(-1, 22)	19.44	6.11	5.33
4	15	81	32	(127, 161)	98.74	(132, 167)	99.67	0.95	(122, 148)	101.31	2.61	1.66
0	3	9	32	(2, 16)	19.19	(3, 18)	19.38	0.99	(5, 22)	20.44	6.50	5.51
0	3	81	32	(15, 31)	33.82	(13, 28)	34.17	1.04	(12, 31)	34.24	1.25	0.21

AVERAGE % ERROR IN TOTAL EXP.COST			0.18		1.84	
AVERAGE EXP.COST FOR EACH CASE	50.58	50.66		51.36		
TOTAL EXP.COST FOR EACH CASE	4855.92	4863.35		4930.50		
AVERAGE % ERROR DIFFERENCE BAD-FOW						1.66
SUMMARY-AVERAGE EXP.COST FOR EACH CASE	8839.62	9000.93		9073.96		
SUMMARY-TOTAL EXP.COST FOR EACH CASE	46.04	46.88		47.26		
TOTAL AVERAGE % ERROR IN TOTAL EXP.COST			1.79		2.90	
TOTAL AVERAGE % ERROR DIFFERENCE BAD-FOW						1.11

APPENDIX C

Single-Item Policies and Costs

In this appendix, the listed items are ordered by the percentage difference between optimal and Naddor Approximation total costs.

COMPARISON OF OPT. POWER & MADDOX APPROXIMATIONS

VARIANCE-TO-MEAN RATIO = 1

*** ORDERED BY MADDOX APPROXIMATION ERROR ***

IN THIS TABLE SET-UP COSTS ARE: 8 AND 16

EXP.COST IS EXP. TOTAL COST

L	M	PI	K	OPTIMAL POLICY (S,S)	OPTIMAL POLICY EXP.COST	POWER APPROXIMATION (S,S)	POWER APPROXIMATION EXP.COST	POWER APPROXIMATION ERROR	MADDOX APPROXIMATION (S,S)	MADDOX APPROXIMATION EXP.COST	MADDOX APPROXIMATION ERROR	COMPARISON MAD-POW	COMPARISON MD<PW
2	15	81	8	(55, 61)	26.34	(55, 60)	26.44	0.36	(56, 61)	26.35	0.01	-0.35	*
2	15	27	8	(51, 57)	23.40	(51, 57)	23.40	0.0	(53, 58)	23.41	0.07	0.07	
4	15	81	8	(99, 95)	31.41	(89, 94)	31.61	0.64	(90, 96)	31.50	0.28	-0.36	*
4	15	27	8	(84, 91)	27.66	(83, 91)	27.67	0.04	(86, 92)	27.78	0.44	0.40	
0	15	81	8	(20, 24)	18.97	(20, 24)	18.97	0.0	(22, 25)	19.05	0.45	0.45	
0	15	27	8	(18, 22)	17.13	(17, 22)	17.13	0.00	(19, 23)	17.22	0.48	0.48	
0	7	3	16	([illegible], 16)	13.51	(3, 17)	13.59	0.60	(3, 17)	13.59	0.60	0.0	
2	15	9	8	(46, 54)	20.10	(46, 54)	20.10	0.0	([illegible], 55)	20.27	0.84	0.84	
0	11	3	16	(5, 22)	16.79	(6, 13)	19.64	16.91	(6, 21)	16.94	0.86	-16.06	*
4	11	81	8	(66, 73)	28.07	(67, 72)	28.14	0.22	(68, 74)	28.32	0.89	0.67	
4	15	9	8	(78, 86)	23.51	(78, 86)	23.51	0.0	(80, 88)	23.74	0.96	0.96	
4	11	27	8	(62, 70)	24.73	(62, 68)	24.92	0.79	(64, 71)	25.04	1.26	0.47	
2	7	9	16	(21, 35)	18.08	(21, 36)	18.11	0.16	(22, 34)	18.31	1.28	1.12	
2	11	9	16	(33, 50)	22.45	(33, 51)	22.50	0.24	(34, 48)	22.74	1.30	1.06	
2	11	3	16	(27, 45)	18.53	(28, 46)	18.58	0.29	([illegible], 44)	18.79	1.39	1.10	
4	3	81	8	(21, 29)	15.09	(22, 29)	15.34	1.75	(22, 28)	15.32	1.61	-0.14	*
4	7	81	16	(43, 57)	26.26	(43, 58)	26.28	0.09	(45, 56)	26.72	1.75	1.66	
4	15	3	8	(71, 83)	18.91	(73, 81)	19.05	0.78	(74, 83)	19.25	1.82	1.04	
2	7	3	16	(16, 32)	14.88	(17, 32)	14.54	0.42	(18, 31)	15.16	1.88	1.46	
2	3	3	16	(6, 17)	9.80	(6, 16)	9.82	0.26	(7, 17)	9.99	1.93	1.67	
4	11	3	16	(49, 69)	19.99	(51, 69)	20.11	0.63	(52, 67)	20.38	1.97	1.34	
2	3	27	16	(11, 21)	13.80	(11, 21)	13.80	0.0	(12, 21)	14.07	2.00	2.00	
4	11	27	16	(61, 76)	28.89	(60, 78)	28.98	0.33	(63, 76)	29.49	2.12	1.79	
4	3	27	8	(19, 26)	13.12	(19, 26)	13.12	0.0	(20, 26)	13.41	2.21	2.21	
2	3	81	16	(13, 22)	15.50	(13, 23)	15.50	0.00	(14, 23)	15.84	2.21	2.21	
2	15	3	16	(38, 60)	21.51	(40, 50)	24.04	11.74	(40, 57)	21.99	2.23	-9.51	*
0	7	9	16	(5, 19)	15.72	(6, 20)	15.83	0.66	(7, 19)	16.10	2.39	1.73	
2	11	9	8	(34, 41)	18.21	(34, 40)	18.34	0.70	(36, 43)	18.66	2.46	1.76	
4	15	3	16	([illegible], 81)	23.17	(70, 81)	26.12	12.71	(71, 88)	23.75	2.51	-10.21	*
2	15	3	8	(40, 50)	16.56	(42, 50)	16.60	0.25	(43, 52)	16.98	2.53	2.27	
4	7	27	16	(40, 54)	23.27	(39, 54)	23.32	0.25	(42, 53)	23.86	2.57	2.32	
0	15	3	16	(8, 30)	19.57	(5, 18)	20.80	6.32	(9, 26)	20.08	2.62	-3.70	*
2	3	9	16	(8, 19)	11.93	(9, 19)	11.94	0.06	(10, 19)	12.25	2.62	2.56	
2	7	27	16	(24, 38)	20.84	(24, 39)	20.89	0.22	(26, 37)	21.39	2.65	2.43	
2	11	27	8	(38, 44)	21.14	(38, 43)	21.29	0.70	(40, 46)	21.71	2.69	1.99	
4	11	9	16	(56, 74)	24.71	(56, 74)	24.71	0.0	(58, 71)	25.37	2.71	2.71	
4	11	81	16	(65, 82)	32.57	(65, 83)	32.61	0.12	(67, 79)	33.46	2.74	2.62	
2	11	81	8	(41, 47)	23.78	(42, 46)	23.87	0.39	(43, 49)	24.46	2.86	2.47	
0	3	3	16	(0, 10)	8.89	(0, 9)	8.93	0.42	(1, 10)	9.15	2.88	2.46	
4	7	3	16	(30, 47)	16.03	(31, 46)	16.09	0.40	(33, 46)	16.50	2.94	2.55	
2	7	81	16	(27, 40)	23.29	(27, 42)	23.38	0.44	(29, 40)	23.99	3.03	2.59	
4	3	81	16	(20, 30)	17.46	(21, 31)	17.54	0.45	(22, 30)	17.99	3.05	2.60	
2	11	81	16	(40, 57)	28.85	(40, 59)	28.93	0.28	(42, 54)	29.74	3.06	2.78	
4	7	9	16	(36, 51)	19.89	(36, 51)	19.88	0.0	(38, 49)	20.50	3.12	3.12	
0	11	9	16	(9, 25)	19.47	(9, 15)	21.92	12.50	(11, 24)	20.09	3.15	-9.39	*
0	7	3	8	(3, 13)	9.96	(4, 9)	10.68	7.20	(5, 13)	10.29	3.23	-3.98	*
4	3	9	16	(15, 26)	13.09	(15, 25)	13.14	0.39	(17, 26)	13.51	3.24	2.85	
2	7	81	8	(28, 37)	19.59	(28, 31)	20.88	6.56	(29, 35)	20.24	3.28	-3.28	*
2	11	3	8	(29, 42)	14.53	(30, 37)	15.08	3.81	(31, 40)	15.02	3.40	-0.41	*

0	3	9	16	(2, 11)	10.36	(2, 11)	10.36	0.0	(3, 12)	10.72	3.48	3.48	
4	11	9	8	(57, 71)	20.65	(57, 65)	21.01	1.74	(60, 67)	21.39	3.59	1.86	
4	15	9	16	(76, 97)	28.69	(76, 86)	31.14	8.52	(78, 93)	29.78	3.78	-4.74	•
2	11	27	16	(37, 53)	25.86	(37, 55)	25.95	0.35	(39, 51)	26.86	3.87	3.52	
4	7	81	8	(44, 54)	22.63	(45, 56)	22.88	1.07	(46, 52)	23.51	3.89	2.82	
0	15	9	8	(15, 20)	15.12	(14, 20)	15.12	0.00	(16, 22)	15.74	4.13	4.12	
4	7	9	8	(37, 48)	16.49	(37, 48)	16.49	0.0	(39, 46)	17.20	4.30	4.30	
2	7	3	8	(10, 29)	11.60	(18, 24)	12.70	9.51	(20, 28)	12.10	4.31	-5.20	•
0	3	81	8	(5, 11)	10.13	(5, 12)	10.17	0.40	(6, 12)	10.57	4.36	3.96	
4	3	27	16	(18, 29)	15.39	(18, 28)	15.39	0.0	(20, 28)	16.06	4.37	4.37	
4	3	3	16	(12, 24)	10.55	(12, 22)	10.64	0.86	(14, 23)	11.03	4.54	3.67	
4	11	3	8	(51, 66)	16.12	(53, 60)	17.16	6.44	(54, 63)	16.89	4.79	-1.65	•
4	3	9	8	(16, 24)	10.90	(16, 23)	10.94	0.39	(18, 24)	11.43	4.81	4.42	
2	3	27	8	(11, 18)	11.43	(12, 19)	11.50	0.61	(13, 18)	11.98	4.82	4.21	
0	15	3	8	(10, 19)	13.05	(11, 18)	13.05	0.00	(11, 20)	13.69	4.93	4.93	
4	7	27	8	(41, 51)	19.74	(41, 52)	19.77	0.16	(43, 49)	20.73	5.05	4.88	
0	11	27	16	(12, 29)	21.70	(12, 17)	23.79	9.63	(14, 26)	22.80	5.07	-4.56	•
4	15	81	16	(87, 108)	37.82	(87, 94)	39.58	4.63	(89, 102)	39.76	5.12	0.49	
2	3	9	8	(9, 17)	9.61	(9, 16)	9.63	0.14	(11, 17)	10.10	5.13	4.99	
0	11	3	8	(7, 14)	12.18	(7, 13)	12.21	0.22	(8, 17)	12.81	5.19	4.97	
0	7	27	16	(8, 20)	17.56	(8, 22)	17.65	0.49	(10, 21)	18.50	5.35	4.86	
4	7	3	8	(32, 44)	12.90	(33, 44)	12.97	0.53	(35, 43)	13.60	5.36	4.83	
2	7	9	8	(22, 32)	14.55	(22, 27)	15.59	7.18	(24, 31)	15.33	5.36	-1.81	•
0	3	27	8	(4, 10)	9.09	(4, 11)	9.13	0.50	(5, 11)	9.58	5.44	4.93	
4	15	27	16	(82, 103)	33.56	(81, 91)	35.50	5.80	(84, 97)	35.38	5.44	-0.36	•
2	3	81	8	(13, 20)	13.02	(14, 21)	13.21	1.44	(15, 20)	13.75	5.55	4.11	
4	3	3	8	(13, 21)	8.53	(13, 20)	8.63	1.22	(15, 21)	9.01	5.66	4.44	
2	7	27	8	(25, 35)	17.19	(25, 29)	18.40	7.01	(27, 33)	18.17	5.68	-1.33	•
0	7	9	8	(6, 16)	11.96	(7, 10)	12.84	7.32	(8, 15)	12.67	5.89	-1.44	•
0	3	3	8	(0, 8)	6.55	(1, 8)	6.59	0.63	(2, 8)	6.94	5.92	5.28	
2	15	9	16	(45, 66)	26.10	(45, 54)	27.97	6.79	(47, 61)	27.66	5.59	-0.80	•
0	7	81	16	(10, 22)	19.19	(10, 24)	19.33	0.72	(12, 23)	20.35	6.03	5.31	
0	7	27	8	(8, 18)	13.73	(9, 12)	14.21	3.50	(10, 16)	14.63	6.58	3.08	
0	11	27	8	(13, 17)	15.88	(13, 17)	15.88	0.0	(14, 20)	16.96	6.77	6.77	
0	11	81	16	(14, 30)	23.64	(15, 19)	25.92	9.61	(17, 29)	25.26	6.85	-2.76	•
0	3	27	16	(3, 13)	11.61	(4, 13)	11.77	1.37	(5, 14)	12.41	6.89	5.52	
0	15	9	16	(13, 33)	22.66	(13, 20)	23.08	1.87	(14, 28)	24.23	6.95	5.08	
0	7	81	8	(10, 19)	15.25	(11, 13)	15.79	3.52	(12, 18)	16.45	7.82	4.30	
2	15	81	16	(54, 74)	33.50	(53, 60)	34.42	2.76	(56, 68)	36.17	7.98	5.22	
2	3	3	8	(6, 15)	7.66	(7, 14)	7.68	0.28	(9, 15)	8.29	8.16	7.88	
2	15	27	16	(50, 70)	30.06	(49, 57)	31.34	4.29	(52, 64)	32.52	8.18	3.90	
0	11	81	8	(15, 19)	17.46	(15, 18)	17.93	2.65	(17, 22)	19.01	8.86	6.21	
0	3	9	8	(2, 9)	7.86	(3, 10)	8.06	2.64	(4, 9)	8.60	9.49	6.85	
0	15	27	16	(16, 22)	25.12	(16, 22)	25.12	0.0	(18, 31)	27.58	9.80	9.80	
0	11	9	8	(10, 15)	14.13	(10, 15)	14.13	0.0	(12, 19)	15.52	9.85	9.85	
0	3	81	16	(5, 14)	12.80	(5, 14)	12.80	0.0	(7, 15)	14.25	11.29	11.29	
0	15	81	16	(19, 24)	26.96	(19, 24)	26.96	0.0	(22, 33)	31.61	17.22	17.22	
AVERAGE % ERROR IN TOTAL EXP.COST								2.17			4.05		
AVERAGE EXP.COST FOR EACH CASE					18.54		18.96			19.26			
TOTAL EXP.COST FOR EACH CASE					1779.46		1820.34			1849.33			
AVERAGE % ERROR DIFFERENCE MAI-POR												1.88	

COMPARISON OF OPT. POWER & NADDOR APPROXIMATIONS

VARIANCE-TO-MEAN RATIO = 1

*** ORDERED BY NADDOR APPROXIMATION ERROR ***

IN THIS TABLE SET-UP COSTS ARE: 32 AND 64

EXP.COST IS EXP. TOTAL COST

				OPTIMAL POLICY		POWER APPROXIMATION			NADDOR APPROXIMATION			COMPARISON	
L	M	PI	K	(S,S)	EXP.COST	(S,S)	EXP.COST	ERROR	(S,S)	EXP.COST	ERROR	NAD-PCW	ND<PW
0	11	3	32	(3, 29)	23.45	(4, 27)	23.57	0.51	(3, 28)	23.45	0.00	-0.51	*
0	11	9	64	(7, 42)	36.74	(7, 40)	36.76	0.07	(7, 41)	36.74	0.01	-0.07	*
0	11	3	64	(0, 38)	32.82	(2, 35)	33.15	1.00	(0, 37)	32.82	0.02	-0.98	*
2	7	3	64	(12, 44)	27.00	(13, 42)	27.15	0.55	(12, 43)	27.01	0.05	-0.49	*
0	15	3	32	(5, 32)	27.20	(7, 34)	27.36	0.61	(6, 33)	27.22	0.08	-0.54	*
2	15	3	64	(31, 76)	39.43	(34, 74)	39.66	0.59	(32, 74)	39.48	0.12	-0.47	*
0	7	9	64	(3, 32)	29.33	(4, 31)	29.39	0.22	(4, 32)	29.36	0.12	-0.10	*
2	15	3	32	(35, 65)	28.89	(37, 66)	29.04	0.51	(36, 64)	28.93	0.14	-0.37	*
4	15	3	64	(61, 107)	40.52	(64, 106)	40.74	0.54	(62, 105)	40.58	0.15	-0.39	*
0	7	3	32	(0, 22)	18.73	(1, 20)	18.83	0.52	(1, 22)	18.76	0.16	-0.36	*
2	11	3	64	(21, 61)	33.80	(23, 58)	34.00	0.60	(22, 59)	33.85	0.16	-0.44	*
4	11	3	64	(43, 84)	34.73	(45, 82)	34.88	0.42	(44, 82)	34.79	0.16	-0.25	*
0	15	3	64	(2, 45)	38.25	(5, 42)	38.71	1.19	(1, 43)	38.32	0.18	-1.01	*
0	15	9	64	(10, 49)	42.70	(11, 48)	42.81	0.27	(11, 49)	42.78	0.20	-0.08	*
0	7	3	64	(-2, 29)	26.21	(0, 27)	26.53	1.23	(-1, 29)	26.27	0.25	-0.98	*
2	15	9	64	(41, 82)	45.25	(41, 81)	45.26	0.00	(42, 80)	45.37	0.26	0.26	
2	15	9	32	(43, 69)	33.89	(43, 72)	34.10	0.61	(44, 69)	33.99	0.29	-0.32	*
2	7	3	32	(14, 37)	19.79	(15, 36)	19.84	0.29	(15, 36)	19.84	0.29	0.0	
4	15	9	64	(72, 114)	47.33	(72, 114)	47.33	0.0	(73, 111)	47.49	0.35	0.35	
2	7	9	64	(18, 49)	31.03	(18, 47)	31.04	0.05	(19, 47)	31.15	0.40	0.35	
4	7	3	64	(25, 59)	27.74	(27, 57)	27.88	0.50	(27, 57)	27.88	0.50	0.0	
4	15	9	32	(74, 101)	36.34	(74, 104)	36.42	0.21	(76, 100)	36.54	0.54	0.33	
4	7	9	64	(33, 63)	32.45	(32, 62)	32.48	0.11	(34, 62)	32.63	0.55	0.44	
0	11	9	32	(8, 32)	26.70	(8, 31)	26.71	0.04	(9, 31)	26.85	0.56	0.52	
0	3	3	64	(-3, 18)	17.17	(-1, 18)	17.52	2.08	(-2, 18)	17.27	0.59	-1.50	*
4	11	3	32	(47, 75)	25.94	(48, 74)	26.04	0.36	(48, 73)	26.10	0.59	0.23	
4	15	3	32	(65, 98)	30.29	(67, 97)	30.41	0.41	(67, 95)	30.47	0.60	0.20	
4	3	3	64	(9, 31)	18.18	(9, 30)	18.21	0.17	(10, 31)	18.30	0.64	0.48	
2	3	3	64	(3, 25)	17.69	(3, 23)	17.75	0.36	(4, 25)	17.80	0.65	0.28	
2	11	9	64	(29, 66)	38.85	(29, 64)	38.89	0.10	(31, 64)	39.11	0.65	0.55	
2	11	3	32	(24, 52)	24.76	(26, 51)	24.87	0.44	(26, 50)	24.93	0.66	0.22	
4	11	9	64	(52, 90)	40.60	(52, 89)	40.60	0.01	(54, 87)	40.92	0.80	0.79	
4	15	27	32	(81, 105)	41.42	(80, 110)	41.70	0.67	(83, 106)	41.75	0.81	0.13	
4	7	3	32	(28, 52)	20.74	(29, 50)	20.84	0.48	(30, 51)	20.92	0.89	0.40	
2	3	9	64	(7, 27)	20.35	(7, 27)	20.35	0.0	(8, 28)	20.54	0.96	0.96	
0	15	9	32	(12, 35)	30.67	(12, 39)	31.14	1.51	(13, 37)	30.97	0.98	-0.53	*
2	7	9	32	(19, 40)	23.34	(19, 40)	23.34	0.0	(21, 40)	23.60	1.13	1.13	
4	7	9	32	(34, 56)	24.93	(34, 55)	24.95	0.07	(36, 55)	25.23	1.20	1.13	
4	11	9	32	(54, 81)	31.18	(54, 80)	31.18	0.00	(56, 78)	31.56	1.20	1.20	
2	11	9	32	(31, 57)	29.19	(31, 56)	29.19	0.01	(33, 55)	29.56	1.25	1.24	
4	15	27	64	(79, 119)	52.85	(78, 120)	52.92	0.13	(82, 118)	53.55	1.31	1.19	
2	15	27	32	(48, 72)	38.01	(48, 77)	38.45	1.15	(51, 73)	38.53	1.35	0.20	
2	11	27	64	(34, 70)	42.85	(34, 69)	42.86	0.02	(37, 70)	43.47	1.45	1.43	
0	7	9	32	(4, 24)	21.32	(5, 24)	21.33	0.08	(6, 24)	21.63	1.48	1.40	
4	11	27	64	(56, 94)	45.41	(57, 94)	45.54	0.30	(61, 93)	46.08	1.49	1.19	
4	15	81	32	(86, 110)	45.77	(85, 115)	46.27	1.09	(89, 111)	46.47	1.53	0.44	
2	3	9	32	(8, 22)	15.33	(8, 22)	15.33	0.0	(9, 23)	15.57	1.53	1.53	
4	11	27	32	(60, 85)	35.68	(59, 85)	35.72	0.11	(62, 83)	36.25	1.60	1.49	
2	15	27	64	(47, 86)	49.82	(46, 86)	49.88	0.11	(50, 86)	50.64	1.64	1.53	

4	3	3	32	(10, 27)	13.61	(11, 26)	13.65	0.31	(12, 26)	13.84	1.68	1.37
4	3	9	64	(13, 34)	21.28	(13, 34)	21.28	0.0	(15, 34)	21.64	1.71	1.71
4	7	27	64	(37, 67)	36.32	(37, 67)	36.32	0.0	(40, 67)	36.94	1.72	1.72
2	11	27	32	(36, 60)	32.90	(35, 60)	32.96	0.16	(38, 59)	33.52	1.86	1.70
2	7	27	32	(23, 43)	26.30	(23, 44)	26.30	0.03	(25, 43)	26.79	1.86	1.83
2	3	3	32	(4, 20)	12.98	(5, 19)	13.05	0.56	(6, 20)	13.22	1.90	1.34
0	3	3	32	(-2, 13)	12.29	(0, 13)	12.53	2.01	(0, 14)	12.53	1.99	-0.02
4	7	27	32	(39, 60)	28.55	(36, 59)	28.59	0.14	(41, 59)	29.13	2.02	1.87
0	3	9	64	(0, 20)	19.22	(0, 19)	19.26	0.19	(2, 21)	19.65	2.22	2.03
4	3	9	32	(14, 29)	16.39	(14, 29)	16.39	0.0	(16, 29)	16.77	2.26	2.26
4	11	81	32	(64, 89)	39.55	(64, 90)	39.56	0.03	(67, 87)	40.45	2.28	2.26
2	11	81	32	(39, 64)	36.08	(39, 64)	36.08	0.0	(42, 63)	36.94	2.39	2.39
4	3	27	32	(17, 32)	18.82	(17, 32)	18.82	0.0	(19, 32)	19.28	2.46	2.46
2	15	81	32	(53, 76)	41.56	(52, 81)	42.18	1.49	([illegible], 78)	42.63	2.58	1.09
4	15	81	64	(84, 124)	57.53	(83, 125)	57.74	0.36	(89, 124)	59.15	2.81	2.45
4	7	81	32	(42, 63)	31.68	(42, 63)	31.68	0.0	(45, 62)	32.59	2.88	2.88
2	7	27	64	(22, 51)	34.23	(22, 51)	34.23	0.0	(25, 52)	35.23	2.91	2.91
4	11	81	64	(63, 98)	49.46	(62, 99)	49.58	0.25	(67, 99)	50.94	2.99	2.74
0	7	27	32	(7, 26)	23.29	(7, 26)	23.29	0.0	(9, 27)	24.00	3.07	3.07
0	15	27	64	(14, 52)	45.83	(14, 51)	45.67	0.09	(18, 54)	47.32	3.27	3.18
0	15	27	32	(15, 38)	33.40	(16, 43)	34.26	2.56	([illegible], 41)	34.52	3.35	0.79
2	3	27	32	(10, 24)	17.33	(10, 24)	17.33	0.0	(12, 25)	17.91	3.39	3.39
2	3	81	32	(12, 26)	19.07	(12, 26)	19.07	0.0	(14, 27)	19.75	3.51	3.51
2	15	81	64	(51, 90)	53.64	(51, 91)	53.66	0.04	(56, 92)	55.54	3.53	3.50
4	7	81	64	(41, 71)	39.59	(41, 71)	39.59	0.0	(45, 72)	41.05	3.69	3.69
4	3	27	64	(16, 37)	23.89	(16, 37)	23.89	0.0	(19, 37)	24.77	3.69	3.69
0	7	27	64	(6, 35)	31.53	(7, 34)	31.60	0.24	(9, 37)	32.70	3.72	3.48
0	11	27	32	(11, 35)	29.20	(11, 34)	29.20	0.02	(14, 35)	30.40	4.12	4.11
4	3	81	32	(20, 34)	20.95	(20, 35)	20.99	0.16	(22, 34)	21.85	4.26	4.10
2	3	27	64	(10, 30)	22.54	(9, 29)	22.55	0.03	(12, 31)	23.50	4.27	4.24
2	7	81	32	(26, 46)	28.85	(26, 47)	28.88	0.09	(29, 46)	30.09	4.29	4.20
0	11	27	64	(10, 44)	39.46	(10, 43)	39.47	0.04	(14, 46)	41.20	4.40	4.37
2	11	81	64	(38, 73)	46.17	(38, 73)	46.17	0.0	(43, 75)	48.34	4.70	4.70
2	7	81	64	(25, 54)	36.93	(25, 54)	36.93	0.0	(29, 56)	38.71	4.84	4.84
0	3	9	32	(1, 15)	13.95	(1, 14)	13.99	0.22	(3, 16)	14.66	5.06	4.84
4	3	81	64	(19, 39)	26.08	(19, 40)	26.10	0.07	(22, 41)	27.43	5.20	5.13
0	15	81	32	(18, 40)	35.69	(18, 45)	36.51	2.32	(22, 44)	37.81	5.95	3.63
0	7	81	32	(9, 28)	24.96	(9, 28)	24.96	0.0	(12, 30)	26.63	6.69	6.69
0	3	27	64	(4, 22)	20.69	(3, 22)	20.78	0.44	(5, 24)	22.16	7.11	6.67
0	3	27	32	(3, 16)	15.31	(3, 16)	15.31	0.0	(5, 18)	16.44	7.33	7.33
2	3	81	64	(12, 31)	24.35	(12, 32)	24.36	0.03	(15, 34)	26.21	7.64	7.61
0	11	81	32	(14, 37)	31.31	(14, 37)	31.31	0.0	(18, 38)	34.04	8.72	8.72
0	7	81	64	(8, 36)	33.34	(9, 36)	33.37	0.09	(13, 40)	36.36	9.06	8.96
0	15	81	64	(17, 55)	48.33	(17, 54)	48.35	0.04	(24, 60)	52.81	9.27	9.23
0	11	81	64	(13, 45)	41.64	(13, 46)	41.64	0.0	(19, 51)	45.88	10.19	10.19
0	3	81	32	(4, 17)	16.48	(5, 18)	16.72	1.45	(7, 20)	18.33	11.25	9.81
0	3	81	64	(4, 23)	21.90	(4, 23)	21.90	0.0	(8, 27)	25.07	14.47	14.47
AVERAGE % ERROR IN TOTAL EXP.COST								0.35			2.53	
AVERAGE EXP.COST FOR EACH CASE					30.80		30.91			31.56		
TOTAL EXP.COST FOR EACH CASE					2957.09		2967.16			3030.05		
AVERAGE % ERROR DIFFERENCE NAI-FCM												2.18
SUMMARY-AVERAGE EXP.COST FOR EACH CASE					24.67		24.93			25.41		
SUMMARY-TOTAL EXP.COST FOR EACH CASE					4736.55		4787.50			4879.38		
TOTAL AVERAGE % ERROR IN TOTAL EXP.COST								1.26			3.29	
TOTAL AVERAGE % ERROR DIFFERENCE NAI-FCM												2.03

COMPARISON OF OPT. POWER & NADDOR APPROXIMATIONS

VARIANCE-TO-MEAN RATIO = 3

*** ORDERED BY NADDOR APPROXIMATION ERROR ***

IN THIS TABLE SET-UP COSTS ARE: 8 AND 16

EXP.COST IS EXP. TOTAL COST

L	R	PI	K	OPTIMAL POLICY (S,S)	OPTIMAL POLICY EXP.COST	POWER APPROXIMATION (S,S)	POWER APPROXIMATION EXP.COST	POWER APPROXIMATION ERROR	NADDOR APPROXIMATION (S,S)	NADDOR APPROXIMATION EXP.COST	NADDOR APPROXIMATION ERROR	COMPARISON NAD-POW	COMPARISON ND<PW
0	11	81	16	(20, 35)	31.40	(20, 38)	31.53	0.41	(20, 34)	31.44	0.13	-0.28	*
0	3	81	16	(8, 18)	17.98	(8, 18)	17.98	0.0	(8, 19)	18.02	0.21	0.21	
0	3	81	8	(9, 16)	15.81	(9, 16)	15.81	0.0	(9, 15)	15.85	0.25	0.25	
0	7	81	16	(14, 28)	25.76	(14, 29)	25.79	0.15	(15, 27)	25.83	0.30	0.15	
2	3	81	16	(19, 29)	23.49	(19, 30)	23.49	0.03	(18, 28)	23.57	0.35	0.31	
0	15	9	8	(16, 25)	21.01	(17, 24)	21.11	0.50	(18, 25)	21.12	0.54	0.04	
0	15	81	16	(25, 42)	36.10	(25, 30)	39.73	10.08	(26, 39)	36.32	0.63	-9.45	*
2	7	81	16	(35, 50)	33.80	(36, 52)	34.02	0.64	(3[illegible], 47)	34.02	0.65	0.01	
4	3	81	16	(28, 39)	27.22	(29, 40)	27.39	0.61	(27, 37)	27.40	0.66	0.05	
0	11	9	16	(10, 27)	22.91	(11, 29)	23.01	0.45	(12, 27)	23.09	0.80	0.35	
0	3	27	16	(5, 15)	15.09	(5, 15)	15.09	0.0	(6, 16)	15.22	0.86	0.86	
0	7	81	8	(15, 24)	22.19	(16, 17)	27.02	21.76	(15, 22)	22.38	0.87	-20.88	*
4	3	27	16	(23, 35)	22.81	(23, 34)	22.81	0.02	(24, 33)	23.01	0.89	0.87	
4	3	27	8	(24, 32)	20.92	(25, 33)	21.01	0.44	(25, 31)	21.13	0.99	0.55	
2	3	27	16	(14, 26)	19.68	(15, 26)	19.69	0.02	([illegible], 25)	19.88	1.02	1.00	
2	7	27	16	(29, 45)	28.81	(29, 45)	28.81	0.0	(31, 43)	29.11	1.03	1.03	
0	15	3	16	(8, 27)	21.44	(8, 20)	22.60	5.39	(10, 27)	21.67	1.05	-4.34	*
0	15	27	8	(24, 30)	25.55	(22, 27)	26.19	2.48	(23, 28)	25.82	1.06	-1.42	*
0	11	27	16	(15, 31)	27.26	(15, 33)	27.32	0.21	(17, 30)	27.56	1.09	0.88	
0	7	27	16	(10, 24)	22.16	(11, 26)	22.27	0.48	(12, 24)	22.40	1.10	0.62	
2	11	81	16	(50, 67)	41.33	(51, 70)	41.54	0.50	(50, 63)	41.79	1.10	0.60	
0	11	27	8	(17, 26)	22.65	(17, 21)	24.03	6.07	(18, 24)	22.92	1.17	-4.90	*
4	7	27	16	(47, 63)	33.49	(47, 63)	33.49	0.0	(48, 60)	33.89	1.18	1.18	
0	11	81	8	(21, 30)	26.67	(22, 24)	29.32	9.91	(21, 27)	27.00	1.23	-8.68	*
0	3	27	8	(6, 13)	12.93	(6, 13)	12.93	0.0	(7, 13)	13.09	1.24	1.24	
0	7	27	8	(11, 21)	18.66	(12, 15)	20.85	11.75	(13, 20)	18.89	1.24	-10.52	*
2	3	81	8	(19, 27)	21.46	(21, 29)	21.76	1.43	(19, 25)	21.74	1.30	-0.13	*
0	7	9	16	(6, 20)	18.45	(7, 22)	18.54	0.49	(8, 21)	18.69	1.32	0.82	
2	15	81	16	(64, 84)	47.58	(65, 71)	51.74	8.73	(65, 78)	48.21	1.32	-7.41	*
2	11	27	16	(43, 61)	35.46	(43, 62)	35.46	0.01	(45, 58)	35.93	1.32	1.32	
4	11	81	16	(78, 96)	48.33	(79, 99)	48.56	0.47	(78, 91)	49.00	1.37	0.91	
2	15	27	16	(57, 77)	40.35	(57, 66)	43.75	6.84	(59, 73)	41.52	1.41	-5.43	*
2	7	27	8	(31, 41)	25.65	(31, 42)	25.65	0.01	(32, 39)	26.01	1.43	1.41	
0	15	27	16	(20, 38)	31.49	(20, 27)	33.71	7.03	(22, 35)	31.94	1.43	-5.60	*
4	11	27	8	(72, 85)	37.47	(72, 78)	39.00	4.10	(73, 81)	38.00	1.43	-2.67	*
2	15	27	8	(59, 71)	36.02	(59, 66)	36.74	1.98	(61, 67)	36.54	1.45	-0.53	*
4	7	81	16	(53, 69)	39.43	(55, 71)	39.64	0.53	(54, 65)	40.00	1.45	0.92	
0	11	3	16	(5, 22)	18.42	(5, 23)	18.42	0.02	(7, 23)	18.69	1.46	1.44	
2	7	81	8	(36, 48)	30.54	(38, 49)	30.98	1.45	(36, 43)	31.00	1.51	0.06	
4	7	9	16	(39, 57)	27.15	(40, 56)	27.18	0.10	(42, 55)	27.57	1.55	1.44	
4	15	27	8	(94, 108)	43.17	(95, 102)	44.11	2.18	(96, 103)	43.87	1.63	-0.55	*
4	7	81	8	(55, 66)	36.32	(58, 70)	37.25	2.54	(55, 62)	36.93	1.66	-0.87	*
4	11	27	16	(70, 89)	41.29	(69, 89)	41.30	0.04	(72, 85)	41.99	1.71	1.67	
2	7	9	8	(25, 36)	20.47	(26, 37)	20.57	0.51	(27, 35)	20.83	1.75	1.24	
4	7	27	8	(48, 60)	30.50	(49, 61)	30.55	0.16	(50, 57)	31.03	1.75	1.59	
4	15	81	16	(101, 122)	55.69	(103, 126)	56.12	0.76	(102, 115)	56.67	1.76	1.00	
4	3	81	8	(29, 37)	25.29	(31, 39)	25.82	2.11	(28, 34)	25.74	1.78	-0.33	*
4	15	81	8	(103, 116)	50.94	(107, 109)	52.53	3.13	(103, 110)	51.85	1.80	-1.33	*
4	15	27	16	(92, 114)	47.72	(92, 115)	47.74	0.05	(94, 108)	48.58	1.80	1.75	

0	11	9	8	(12, 22)	18.46	(12, 18)	19.11	3.51	(14, 21)	18.80	1.87	-1.65	*
2	15	9	8	(51, 64)	29.15	(52, 60)	29.63	1.64	(54, 61)	29.71	1.90	0.26	
0	15	9	16	(14, 33)	26.60	(15, 24)	28.06	5.47	(17, 31)	27.12	1.93	-3.54	*
2	11	9	16	(36, 55)	29.13	(36, 55)	29.13	0.0	(39, 53)	29.71	1.98	1.98	
2	11	81	8	(51, 63)	37.14	(54, 55)	40.22	8.29	(51, 58)	37.87	1.99	-6.30	*
2	3	27	8	(15, 23)	17.69	(16, 24)	17.72	0.12	(17, 22)	18.06	2.05	1.93	
0	15	3	8	(10, 21)	16.37	(11, 20)	16.45	0.48	(13, 22)	16.71	2.09	1.61	
4	15	9	8	(84, 100)	34.75	(85, 94)	35.46	2.04	(88, 96)	35.48	2.11	0.07	
0	11	3	8	(7, 18)	14.25	(7, 15)	14.55	2.14	(9, 18)	14.56	2.16	0.02	
4	11	9	16	(61, 81)	33.66	(61, 81)	33.66	0.0	(64, 78)	34.39	2.16	2.16	
4	3	9	16	(18, 30)	18.20	(18, 29)	18.22	0.13	(20, 29)	18.60	2.21	2.08	
4	3	9	8	(19, 28)	16.37	(20, 28)	16.47	0.56	(21, 27)	16.74	2.21	1.65	
2	11	3	16	(27, 48)	22.50	(29, 48)	22.59	0.40	(31, 47)	23.00	2.21	1.81	
2	7	9	16	(23, 39)	23.51	(23, 39)	23.51	0.0	(26, 38)	24.04	2.24	2.24	
4	15	9	16	(82, 105)	39.03	(82, 105)	39.03	0.0	(85, 100)	39.93	2.31	2.31	
0	7	3	16	(2, 17)	14.73	(2, 17)	14.73	0.0	(4, 18)	15.08	2.34	2.34	
2	15	81	8	(66, 77)	42.40	(69, 71)	44.18	4.20	(66, 72)	43.42	2.39	-1.61	*
2	11	27	8	(45, 57)	31.38	(46, 51)	32.79	4.49	(47, 53)	32.15	2.44	-2.04	*
4	11	9	8	(63, 77)	30.03	(64, 71)	31.24	4.02	(66, 74)	30.78	2.48	-1.55	*
2	15	3	16	(39, 62)	26.17	(40, 53)	28.01	7.03	(43, 60)	26.65	2.62	-4.41	*
4	11	81	8	(79, 92)	44.36	(83, 84)	47.11	6.20	(80, 86)	45.53	2.63	-3.56	*
2	15	9	16	(49, 70)	33.78	(49, 60)	35.93	6.38	(52, 66)	34.67	2.64	-3.74	*
4	7	9	8	(41, 54)	24.29	(42, 54)	24.33	0.16	(44, 51)	24.99	2.88	2.71	
4	7	3	16	(31, 50)	20.53	(32, 48)	20.66	0.63	(35, 49)	21.13	2.94	2.31	
4	11	3	16	(50, 73)	25.61	(52, 72)	25.72	0.44	(55, 71)	26.36	2.94	2.50	
4	11	3	8	(53, 69)	22.26	(56, 64)	23.31	4.70	(57, 67)	22.92	2.95	-1.75	*
2	11	9	8	(38, 51)	25.26	(39, 46)	26.08	3.25	(41, 48)	26.01	2.97	-0.27	*
2	3	3	16	(5, 18)	11.88	(6, 17)	11.90	0.14	(8, 18)	12.25	3.10	2.95	
4	15	3	16	(69, 95)	29.79	(72, 95)	29.92	0.44	(75, 92)	30.74	3.21	2.77	
4	7	3	8	(33, 47)	17.88	(35, 47)	18.02	0.78	(37, 46)	18.47	3.33	2.56	
2	15	3	8	(41, 57)	21.95	(44, 53)	22.55	2.77	(46, 55)	22.68	3.34	0.57	
0	15	81	8	(27, 34)	29.91	(27, 30)	31.92	6.75	(26, 31)	30.92	3.38	-3.36	*
2	7	3	16	(16, 34)	18.04	(17, 33)	18.08	0.22	(20, 33)	18.66	3.44	3.22	
0	7	9	8	(7, 17)	15.03	(8, 13)	15.89	5.75	(10, 17)	15.55	3.45	-2.30	*
4	3	3	16	(12, 25)	13.53	(13, 24)	13.63	0.74	(15, 25)	14.00	3.48	2.75	
0	3	3	16	(-1, 10)	9.62	(0, 10)	9.67	0.52	(1, 11)	9.97	3.62	3.10	
0	3	9	16	(2, 12)	12.26	(3, 13)	12.36	0.83	(4, 14)	12.73	3.81	2.98	
2	11	3	8	(30, 44)	18.91	(32, 40)	19.69	4.09	(34, 43)	19.64	3.83	-0.26	*
2	3	9	16	(10, 22)	15.75	(10, 21)	15.76	0.04	(13, 22)	16.35	3.83	3.79	
4	15	3	8	(73, 91)	25.87	(76, 85)	26.82	3.66	(78, 87)	26.88	3.90	0.24	
0	7	3	8	(3, 13)	11.47	(4, 10)	12.08	5.35	(6, 14)	11.97	4.38	-0.97	*
2	7	3	8	(18, 31)	15.20	(20, 31)	15.34	0.97	(22, 30)	15.88	4.48	3.50	
2	3	9	8	(11, 20)	13.83	(12, 20)	13.88	0.39	(14, 19)	14.48	4.70	4.32	
0	3	9	8	(3, 10)	10.11	(4, 11)	10.27	1.63	(5, 11)	10.59	4.77	3.14	
4	3	3	8	(13, 23)	11.82	(15, 23)	11.98	1.28	(17, 23)	12.52	5.90	4.62	
2	3	3	8	(7, 16)	10.05	(8, 16)	10.15	0.98	(10, 16)	10.69	6.42	5.44	
0	3	3	8	(0, 8)	7.52	(1, 8)	7.59	1.04	(3, 9)	8.33	10.87	9.82	

AVERAGE % ERROR IN TOTAL EXP.COST			2.30		2.17	
AVERAGE EXP.COST FOR EACH CASE	25.88	26.53		26.38		
TOTAL EXP.COST FOR EACH CASE	2484.92	2547.33		2532.66		
AVERAGE % ERROR DIFFERENCE BAD-LOW						-0.14

COMPARISON OF OPT. POWER & NADDOR APPROXIMATIONS

VARIANCE-TO-MEAN RATIO = 3

*** ORDERED BY NADDOR APPROXIMATION ERROR ***

IN THIS TABLE SET-UP COSTS ARE: 32 AND 64

EXP.COST IS EXP. TOTAL COST

				OPTIMAL POLICY		POWER APPROXIMATION			NADDOR APPROXIMATION			COMPARISON	
L	M	PI	K	(S,S)	EXP.COST	(S,S)	EXP.COST	ERROR	(S,S)	EXP.COST	ERROR	NAD-POW	ND<PW
0	15	3	64	(1, 45)	39.27	(2, 42)	35.38	0.29	(2, 45)	39.27	0.01	-0.28	*
2	3	81	32	(18, 33)	26.60	(17, 32)	26.62	0.09	(16, 32)	26.60	0.02	-0.08	*
2	3	81	64	(17, 37)	31.31	(16, 38)	31.33	0.06	(17, 36)	31.32	0.03	-0.03	*
0	11	3	64	(-1, 38)	33.65	(0, 35)	33.75	0.29	(0, 38)	33.67	0.04	-0.25	*
4	3	81	64	(25, 47)	34.79	(25, 48)	34.82	0.08	(26, 47)	34.81	0.06	-0.02	*
0	15	3	32	(5, 35)	28.65	(5, 34)	28.65	0.02	(6, 35)	28.68	0.12	0.10	
4	3	81	32	(27, 42)	30.23	(27, 43)	30.24	0.06	(27, 41)	30.26	0.13	0.07	
4	7	81	64	(50, 81)	51.33	(49, 81)	51.43	0.20	([illegible], 80)	51.40	0.13	-0.06	*
2	7	81	64	([illegible], 62)	46.14	(31, 62)	46.23	0.19	(33, 62)	46.22	0.18	-0.01	*
2	7	81	32	(33, 55)	38.75	(33, 55)	38.75	0.0	(34, 53)	38.83	0.19	0.19	
4	11	81	64	(74, 111)	63.46	(73, 113)	63.51	0.08	(75, 109)	63.63	0.26	0.19	
2	11	81	64	(47, 83)	57.04	(46, 84)	57.05	0.02	(48, 82)	57.19	0.27	0.24	
0	15	9	64	(10, 51)	45.41	(10, 50)	45.43	0.04	(12, 51)	45.54	0.27	0.23	
4	15	81	64	(97, 140)	73.50	(95, 140)	73.64	0.19	(98, 136)	73.72	0.30	0.11	
2	11	81	32	(48, 74)	47.63	(48, 75)	47.66	0.05	([illegible], 71)	47.79	0.32	0.27	
0	15	9	32	(13, 40)	34.18	(13, 42)	34.23	0.13	(14, 40)	34.30	0.33	0.21	
2	15	3	64	(31, 78)	42.45	(32, 76)	42.52	0.18	(33, 76)	42.60	0.36	0.17	
0	7	3	64	(-2, 29)	26.87	(-2, 27)	26.92	0.19	(-1, 30)	26.96	0.37	0.17	
2	11	3	64	(21, 62)	36.39	(21, 59)	36.52	0.35	(23, 61)	36.54	0.40	0.05	
2	7	3	64	(11, 45)	29.06	(11, 42)	29.19	0.45	(13, 45)	29.18	0.40	-0.05	*
4	7	27	64	(43, 75)	45.11	(42, 74)	45.22	0.24	(45, 74)	45.32	0.45	0.21	
2	15	81	32	(63, 91)	54.97	(62, 93)	55.04	0.12	(63, 87)	55.22	0.46	0.33	
4	11	27	64	(65, 104)	56.02	(64, 104)	56.10	0.14	(67, 101)	56.28	0.46	0.31	
4	7	81	32	(52, 74)	44.16	(52, 75)	44.17	0.03	(52, 71)	44.36	0.46	0.43	
0	11	3	32	(2, 29)	24.59	(2, 27)	24.63	0.15	(4, 29)	24.70	0.46	0.31	
2	7	27	32	(28, 50)	33.64	(27, 49)	33.69	0.15	(29, 48)	33.80	0.46	0.31	
0	7	3	32	(0, 22)	19.63	(0, 21)	19.64	0.03	(1, 23)	19.72	0.46	0.44	
0	11	81	32	(19, 42)	38.14	(19, 44)	38.19	0.14	(20, 43)	38.33	0.50	0.35	
4	15	27	64	(87, 131)	65.04	(85, 130)	65.24	0.30	(89, 127)	65.39	0.54	0.24	
4	3	27	32	(22, 38)	25.74	(21, 37)	25.78	0.14	(23, 37)	25.88	0.55	0.41	
2	7	27	64	(26, 57)	40.91	(25, 56)	41.02	0.29	(28, 57)	41.13	0.55	0.27	
2	15	27	64	(53, 95)	59.01	(52, 96)	59.03	0.04	(55, 93)	59.33	0.56	0.51	
2	11	27	32	(42, 68)	41.61	(41, 68)	41.62	0.01	(43, 65)	41.85	0.57	0.57	
2	15	81	64	(61, 102)	66.03	(60, 104)	66.08	0.08	(63, 100)	66.42	0.60	0.52	
4	11	81	32	(76, 102)	54.37	(76, 104)	54.40	0.07	(76, 98)	54.69	0.60	0.53	
0	7	9	64	(4, 33)	31.15	(3, 32)	31.19	0.12	(5, 35)	31.34	0.63	0.50	
0	3	81	32	(7, 21)	21.31	(7, 21)	21.31	0.0	(8, 23)	21.45	0.63	0.63	
4	3	27	64	(20, 42)	30.22	(20, 43)	30.23	0.04	(22, 42)	30.42	0.65	0.61	
2	11	27	64	(40, 77)	50.82	(39, 77)	50.83	0.01	(42, 76)	51.17	0.69	0.68	
2	15	9	64	(43, 87)	51.19	(43, 87)	51.19	0.0	(46, 85)	51.55	0.71	0.71	
0	11	9	64	(7, 43)	38.95	(7, 42)	38.96	0.03	(9, 44)	39.23	0.72	0.69	
4	11	9	64	(55, 96)	47.80	(54, 94)	47.91	0.22	(58, 93)	48.15	0.72	0.51	
2	11	9	64	(31, 70)	43.97	(31, 69)	43.98	0.02	(34, 69)	44.30	0.75	0.72	
4	7	3	64	(25, 61)	30.96	(25, 57)	31.17	0.67	(28, 60)	31.20	0.75	0.08	
4	11	3	64	(43, 87)	38.75	(43, 83)	38.90	0.37	(46, 84)	39.05	0.75	0.38	
2	15	27	32	(55, 84)	48.17	(54, 85)	48.23	0.12	(57, 81)	48.55	0.80	0.68	
4	7	27	32	(45, 66)	38.10	(44, 67)	38.20	0.24	(47, 66)	38.41	0.80	0.56	
4	15	3	64	(61, 111)	45.19	(62, 107)	45.36	0.38	(65, 108)	45.58	0.87	0.49	
2	3	27	32	(13, 29)	22.74	(13, 28)	22.75	0.05	(15, 29)	22.94	0.87	0.82	

2	11	9	32	(34, 61)	35.05	(34, 61)	35.05	0.0	(36, 59)	35.36	0.87	0.87
2	3	3	64	(2, 25)	19.03	(1, 23)	19.19	0.68	(4, 26)	19.20	0.91	0.02
4	15	9	64	(76, 122)	55.64	(75, 120)	55.67	0.06	(79, 118)	56.15	0.93	0.87
2	7	9	64	(19, 51)	35.24	(19, 50)	35.26	0.06	(22, 51)	35.57	0.94	0.88
4	15	81	32	(99, 129)	62.79	(99, 131)	62.85	0.10	(100, 123)	63.38	0.94	0.84
4	15	27	32	(90, 121)	54.61	(88, 120)	54.74	0.23	(92, 116)	55.17	1.02	0.79
4	7	9	64	(35, 68)	38.32	(34, 66)	38.46	0.35	(38, 67)	38.72	1.03	0.68
0	11	27	32	(14, 38)	33.89	(14, 39)	33.91	0.06	(16, 38)	34.24	1.05	0.99
2	3	27	64	(14, 33)	27.37	(12, 34)	27.38	0.02	(14, 35)	27.67	1.07	1.05
0	15	81	32	(24, 50)	43.96	(24, 53)	44.09	0.28	(26, 49)	44.44	1.07	0.79
4	7	9	32	(37, 61)	31.58	(37, 60)	31.61	0.11	(40, 60)	31.93	1.11	1.00
0	15	27	32	(19, 45)	39.27	(19, 48)	39.37	0.25	(21, 45)	39.72	1.14	0.88
2	15	9	32	(46, 77)	40.72	(46, 77)	40.72	0.0	(49, 74)	41.19	1.15	1.15
0	7	81	32	(13, 33)	31.04	(13, 34)	31.05	0.06	(15, 34)	31.39	1.16	1.10
0	11	9	32	(9, 33)	29.39	(9, 34)	29.40	0.01	(11, 34)	29.73	1.16	1.15
0	7	27	32	(9, 29)	27.38	(9, 30)	27.38	0.02	(11, 31)	27.70	1.18	1.16
4	3	9	64	(15, 37)	25.37	(14, 37)	25.41	0.16	(17, 38)	25.67	1.20	1.04
4	11	5	32	(56, 87)	39.26	(58, 86)	39.28	0.05	(61, 84)	39.74	1.22	1.17
0	11	27	64	(13, 48)	43.67	(12, 47)	43.68	0.02	(15, 50)	44.21	1.22	1.20
4	11	27	32	(68, 95)	47.15	(67, 95)	47.16	0.02	(70, 91)	47.75	1.27	1.24
2	15	3	32	(35, 69)	32.65	(36, 67)	32.69	0.14	(39, 67)	33.07	1.29	1.15
2	7	9	32	(21, 44)	28.18	(21, 43)	28.21	0.09	(24, 43)	28.57	1.39	1.30
4	15	9	32	(79, 112)	45.61	(78, 110)	45.66	0.11	(82, 107)	46.25	1.40	1.29
0	15	27	64	(17, 57)	50.74	(17, 57)	50.74	0.0	(20, 58)	51.45	1.41	1.41
2	11	3	32	(24, 54)	28.03	(25, 52)	28.09	0.22	(28, 53)	28.44	1.45	1.23
0	7	9	32	(5, 26)	23.56	(5, 26)	23.56	0.0	(7, 27)	23.92	1.52	1.52
4	3	3	64	(8, 32)	20.31	(8, 31)	20.33	0.14	(11, 33)	20.63	1.60	1.47
2	7	3	32	(14, 38)	22.42	(14, 36)	22.52	0.45	(17, 38)	22.78	1.61	1.16
4	15	3	32	(66, 102)	35.87	(67, 99)	35.99	0.32	(70, 98)	36.46	1.63	1.31
2	3	9	32	(9, 25)	18.73	(9, 24)	18.74	0.05	(11, 25)	19.04	1.67	1.62
4	11	3	32	(47, 79)	30.80	(48, 76)	30.92	0.39	(51, 76)	31.34	1.75	1.36
2	3	9	64	(8, 29)	23.27	(7, 29)	23.30	0.13	(10, 30)	23.68	1.76	1.62
4	7	3	32	(28, 54)	24.65	(29, 52)	24.76	0.45	(32, 53)	25.12	1.91	1.46
0	3	9	64	(0, 20)	20.44	(0, 20)	20.44	0.0	(2, 23)	20.84	1.95	1.95
0	15	81	64	(22, 62)	55.59	(22, 62)	55.59	0.0	(26, 64)	56.72	2.03	2.03
4	3	9	32	(16, 33)	21.02	(16, 32)	21.04	0.09	(19, 33)	21.48	2.15	2.06
4	3	3	32	(10, 28)	16.20	(10, 26)	16.30	0.60	(13, 28)	16.55	2.17	1.56
0	3	3	64	(-3, 18)	17.57	(-3, 17)	17.57	0.02	(-1, 19)	17.97	2.29	2.28
0	7	81	64	(12, 41)	38.81	(12, 41)	38.81	0.0	(15, 44)	39.75	2.43	2.43
0	7	27	64	(6, 37)	35.08	(8, 37)	35.08	0.0	(11, 40)	35.95	2.48	2.48
0	11	81	64	(17, 52)	48.00	(17, 52)	48.00	0.0	(21, 55)	49.24	2.57	2.57
0	3	27	32	(4, 18)	18.41	(5, 19)	18.46	0.30	(6, 21)	18.90	2.68	2.38
0	3	9	32	(1, 16)	15.54	(1, 15)	15.55	0.02	(3, 18)	16.00	2.94	2.92
0	3	3	32	(-2, 13)	12.82	(-1, 13)	12.87	0.39	(0, 15)	13.22	3.12	2.73
2	3	3	32	(4, 21)	14.70	(4, 19)	14.77	0.46	(7, 22)	15.23	3.60	3.13
0	3	81	64	(6, 26)	26.28	(6, 26)	26.28	0.0	(9, 30)	27.24	3.66	3.66
0	3	27	64	(3, 23)	23.35	(4, 24)	23.37	0.06	(6, 27)	24.29	4.01	3.55

AVERAGE % ERROR IN TOTAL EXP.COST			0.15		1.07	
AVERAGE EXP.COST FOR EACH CASE	36.82	36.87		37.16		
TOTAL EXP.COST FOR EACH CASE	3534.39	3539.24		3567.32		
AVERAGE % ERROR DIFFERENCE BAC-ECN						0.92
SUMMARY-AVERAGE EXP.COST FOR EACH CASE	6019.30	6086.57		6099.57		
SUMMARY-TOTAL EXP.COST FOR EACH CASE	31.35	31.70		31.77		
TOTAL AVERAGE % ERROR IN TOTAL EXP.COST			1.23		1.62	
TOTAL AVERAGE % ERROR DIFFERENCE BAC-ECN						0.39

COMPARISON OF OPT. ECHER & NADDOR APPROXIMATIONS

VARIANCE-TO-MEAN RATIO = 5

*** ORDERED BY NADDOR APPROXIMATION ERROR ***

IN THIS TABLE SET-UP COSTS ARE: 8 AND 16

EXP.COST IS EXP. TOTAL COST

L	N	PI	K	OPTIMAL POLICY (S,S)	OPTIMAL POLICY EXP.COST	ECHER APPROXIMATION (S,S)	ECHER EXP.COST	ECHER ERROR	NADDOR APPROXIMATION (S,S)	NADDOR EXP.COST	NADDOR ERROR	COMPARISON NAD-ECH	COMPARISON ND<EC
0	7	27	16	(17, 32)	33.41	(17, 33)	33.41	0.02	(17, 31)	33.45	0.12	0.10	
0	3	27	8	(10, 19)	21.98	(12, 20)	22.15	0.79	(11, 18)	22.01	0.12	-0.67	*
2	3	27	16	(22, 35)	33.13	(23, 35)	33.13	0.02	(22, 33)	33.23	0.30	0.28	
0	3	27	16	(9, 20)	23.55	(10, 21)	23.60	0.23	(10, 22)	23.67	0.50	0.27	
0	11	27	16	(23, 41)	40.21	(24, 43)	40.29	0.20	(23, 39)	40.44	0.57	0.36	
4	3	27	16	(33, 46)	39.18	(35, 47)	39.28	0.26	(33, 43)	39.46	0.71	0.45	
4	3	9	8	(24, 34)	27.58	(25, 38)	28.42	3.05	(27, 34)	27.81	0.80	-2.24	*
2	7	27	16	(41, 59)	46.60	(42, 59)	46.65	0.10	(40, 54)	47.02	0.89	0.79	
0	15	27	16	(29, 49)	45.70	(29, 36)	50.53	10.57	(29, 44)	46.17	1.03	-9.54	*
2	3	27	8	(24, 33)	31.66	(26, 34)	31.81	0.47	(23, 30)	31.99	1.04	0.56	
4	3	9	16	(22, 36)	28.98	(25, 37)	29.16	0.62	(26, 36)	29.31	1.15	0.53	
2	11	9	16	(43, 65)	43.39	(46, 67)	43.63	0.54	(47, 62)	43.94	1.26	0.71	
0	15	9	16	(18, 35)	35.42	(20, 30)	37.32	5.35	(22, 38)	35.88	1.29	-4.06	*
2	3	9	8	(15, 24)	22.68	(16, 26)	23.04	1.61	(18, 25)	22.98	1.36	-0.25	*
0	7	27	8	(18, 30)	30.75	(20, 31)	30.88	0.42	(18, 26)	31.17	1.37	0.95	
0	7	9	8	(10, 21)	22.27	(13, 24)	22.74	2.12	(13, 22)	22.58	1.42	-0.70	*
4	7	27	16	(61, 80)	55.40	(64, 82)	55.57	0.32	(61, 74)	56.19	1.43	1.11	
4	7	9	16	(47, 67)	42.36	(51, 69)	42.71	0.82	(52, 65)	42.97	1.45	0.63	
2	7	9	16	(29, 47)	35.38	(31, 48)	35.52	0.41	(33, 46)	35.89	1.45	1.04	
0	11	9	16	(13, 32)	30.75	(15, 34)	30.92	0.56	(17, 32)	31.19	1.45	0.89	
0	15	9	8	(21, 35)	31.27	(23, 30)	32.06	2.52	(24, 32)	31.77	1.59	-0.93	*
4	3	27	8	(35, 45)	37.78	(39, 48)	38.46	1.81	(34, 40)	38.38	1.61	-0.21	*
0	11	9	8	(15, 28)	27.29	(18, 24)	28.17	3.25	(19, 27)	27.73	1.64	-1.61	*
4	11	27	16	(87, 110)	67.12	(91, 112)	67.41	0.43	(88, 102)	68.24	1.68	1.25	
2	11	9	8	(46, 61)	40.31	(50, 55)	41.92	3.97	(50, 58)	41.01	1.73	-2.24	*
2	11	27	16	(57, 78)	56.24	(59, 80)	56.37	0.23	(57, 71)	57.21	1.73	1.50	
4	7	9	8	(49, 64)	40.11	(55, 67)	40.77	1.66	(54, 61)	40.80	1.73	0.08	
2	15	27	16	(73, 96)	64.15	(75, 99)	64.35	0.32	(73, 88)	65.28	1.76	1.44	
4	11	9	8	(73, 91)	49.10	(80, 84)	51.18	4.24	(78, 86)	49.97	1.76	-2.47	*
2	3	9	16	(13, 26)	24.14	(16, 28)	24.44	1.24	(17, 27)	24.57	1.77	0.54	
2	7	9	8	(31, 44)	32.99	(35, 47)	33.50	1.55	(35, 42)	33.59	1.81	0.27	
2	15	9	16	(57, 82)	49.95	(60, 84)	50.19	0.48	(62, 77)	50.86	1.82	1.34	
4	11	9	16	(70, 94)	52.01	(74, 95)	52.22	0.41	(76, 90)	52.96	1.83	1.42	
4	7	27	8	(64, 78)	53.07	(69, 81)	53.81	1.39	(63, 71)	54.05	1.84	0.45	
4	15	27	16	(112, 138)	76.77	(116, 140)	77.05	0.37	(113, 128)	78.22	1.89	1.52	
2	7	27	8	(43, 56)	44.16	(46, 58)	44.51	0.79	(42, 50)	45.00	1.90	1.11	
4	15	9	8	(97, 116)	56.49	(103, 108)	58.42	3.42	(102, 110)	57.59	1.95	-1.48	*
2	15	9	8	(60, 77)	46.28	(65, 71)	47.70	3.06	(64, 72)	47.20	1.99	-1.07	*
4	15	9	16	(93, 120)	59.93	(97, 121)	60.16	0.37	(99, 114)	61.13	2.00	1.62	
0	7	9	16	(6, 24)	24.94	(10, 26)	25.13	0.79	(12, 26)	25.51	2.31	1.52	
4	11	27	8	(90, 106)	64.10	(94, 95)	68.59	7.01	(90, 98)	65.58	2.31	-4.69	*
4	15	3	8	(76, 98)	39.76	(87, 93)	41.63	4.71	(85, 95)	40.61	2.63	-2.08	*
2	11	27	8	(60, 75)	53.07	(63, 64)	57.51	8.37	(59, 67)	54.47	2.64	-5.73	*
2	15	3	8	(44, 63)	32.45	(51, 59)	33.56	3.42	(51, 61)	33.31	2.64	-0.78	*
2	11	3	8	(31, 48)	27.94	(38, 45)	29.05	3.98	(38, 48)	28.69	2.67	-1.31	*
2	15	3	16	(40, 67)	35.91	(45, 69)	36.30	1.11	(48, 66)	36.90	2.78	1.67	
4	7	3	8	(35, 51)	27.52	(43, 55)	28.71	4.32	(42, 51)	28.32	2.92	-1.40	*
4	15	27	8	(115, 133)	73.17	(121, 122)	76.92	5.13	(116, 123)	75.36	2.99	-2.14	*
4	11	3	8	(56, 75)	34.25	(65, 70)	36.17	5.61	(64, 73)	35.29	3.04	-2.57	*

4	11	3	16	(52, 78)	36.98	(59, 80)	37.58	1.63	(61, 77)	38.11	3.05	1.42	
0	11	27	8	(25, 38)	36.72	(26, 29)	40.11	9.25	(25, 32)	37.85	3.09	-6.15	*
0	15	3	16	(7, 29)	25.79	(9, 23)	26.54	2.89	(13, 31)	26.60	3.13	0.23	
4	15	3	16	(72, 102)	42.98	(80, 104)	43.67	1.60	(82, 99)	44.33	3.15	1.55	
2	7	3	8	(19, 33)	22.41	(25, 37)	23.30	3.96	(25, 34)	23.12	3.17	-0.79	*
2	11	3	16	(28, 52)	30.87	(33, 54)	31.28	1.33	(36, 52)	31.90	3.34	2.01	
4	7	3	16	(32, 54)	29.66	(38, 56)	30.24	1.96	(40, 54)	30.66	3.37	1.41	
0	15	3	8	(10, 25)	21.75	(13, 23)	22.04	1.31	(16, 25)	22.49	3.39	2.07	
2	7	3	16	(17, 36)	24.71	(20, 37)	24.96	0.98	(23, 37)	25.56	3.41	2.43	
0	11	3	16	(4, 23)	22.09	(6, 25)	22.25	0.74	(9, 26)	22.88	3.61	2.86	
2	15	27	8	(76, 92)	60.35	(80, 81)	64.27	6.49	(75, 82)	62.71	3.92	-2.58	*
0	7	81	16	(25, 41)	42.31	(25, 41)	42.31	0.0	(21, 36)	43.97	3.92	3.92	
0	3	81	16	(16, 28)	31.31	(15, 26)	31.49	0.59	(12, 25)	32.57	4.04	3.45	
4	15	81	16	(130, 154)	92.87	(140, 164)	95.53	2.87	(125, 140)	96.82	4.26	1.39	
0	11	3	8	(6, 20)	18.68	(9, 18)	18.96	1.52	(12, 21)	19.50	4.42	2.90	
4	3	3	16	(14, 26)	19.49	(16, 28)	19.87	1.95	(18, 29)	20.36	4.45	2.49	
4	7	81	16	(75, 94)	68.18	(82, 100)	69.78	2.35	(70, 83)	71.39	4.56	2.21	
4	11	81	16	(103, 125)	81.71	(112, 133)	83.88	2.65	(98, 112)	85.60	4.76	2.11	
4	3	3	8	(14, 24)	18.14	(20, 29)	19.28	6.29	(20, 27)	19.03	4.94	-1.35	*
2	11	81	16	(71, 91)	68.86	(75, 96)	69.66	1.16	(65, 80)	72.33	5.04	3.88	
0	15	27	8	(31, 45)	41.48	(33, 36)	44.65	7.63	(31, 37)	43.60	5.10	-2.53	*
0	15	81	16	(40, 59)	56.11	(40, 41)	70.16	25.04	(33, 50)	58.97	5.10	-19.94	*
0	11	81	16	(33, 51)	49.93	(33, 52)	49.95	0.03	(28, 43)	52.59	5.33	5.30	
2	15	81	16	(86, 110)	77.94	(93, 117)	79.11	1.50	(82, 97)	82.17	5.42	3.93	
2	7	81	16	(52, 70)	57.81	(55, 72)	58.07	0.45	(47, 60)	61.20	5.85	5.40	
4	3	81	16	(44, 57)	49.53	(47, 59)	49.90	0.75	(38, 49)	52.51	6.01	5.26	
0	7	3	16	(1, 16)	17.50	(2, 18)	17.58	0.46	(6, 20)	18.58	6.17	5.71	
2	3	81	16	(32, 44)	42.45	(33, 45)	42.51	0.13	(26, 38)	45.11	6.25	6.13	
4	11	81	8	(106, 121)	78.62	(104, 105)	87.58	11.39	(100, 108)	83.64	6.39	-5.01	*
2	3	3	8	(7, 16)	14.62	(11, 19)	15.32	4.79	(12, 19)	15.55	6.41	1.62	
0	3	9	8	(4, 12)	14.90	(7, 15)	15.61	4.75	(8, 15)	15.86	6.43	1.68	
4	7	81	8	(77, 91)	65.81	(89, 101)	69.77	6.02	(71, 79)	70.40	6.98	0.96	
2	3	3	16	(5, 18)	16.06	(8, 20)	16.40	2.12	(11, 21)	17.21	7.13	5.01	
0	3	81	8	(18, 26)	29.76	(17, 25)	29.81	0.18	(13, 21)	31.88	7.15	6.97	
0	7	3	8	(3, 14)	14.81	(5, 16)	15.10	1.99	(8, 17)	15.89	7.30	5.32	
4	15	81	8	(133, 150)	89.16	(132, 133)	97.42	9.26	(128, 134)	95.73	7.36	-1.89	*
0	3	9	16	(3, 13)	16.54	(5, 16)	16.95	2.45	(7, 18)	17.79	7.55	5.10	
4	3	81	8	(45, 55)	48.11	(52, 61)	49.83	3.57	(39, 46)	52.18	8.46	4.89	
2	7	81	8	(54, 67)	55.34	(61, 73)	56.93	2.87	(48, 56)	60.40	9.14	6.27	
2	11	81	8	(73, 88)	65.62	(71, 72)	75.02	14.33	(67, 74)	71.88	9.53	-4.79	*
2	15	81	8	(90, 106)	74.04	(89, 90)	82.97	12.05	(85, 91)	81.22	9.69	-2.36	*
0	7	81	8	(27, 39)	39.65	(28, 39)	39.67	0.05	(22, 30)	43.55	9.82	9.77	
2	3	81	8	(33, 43)	40.99	(36, 44)	41.25	0.65	(27, 34)	45.26	10.42	9.77	
0	3	3	16	(-1, 8)	10.96	(0, 11)	11.34	3.43	(2, 13)	12.26	11.80	8.37	
0	11	81	8	(35, 48)	46.42	(32, 33)	58.38	25.77	(29, 37)	52.01	12.03	-13.73	*
0	15	81	8	(42, 55)	51.85	(40, 41)	62.29	20.13	(36, 42)	60.42	16.53	-3.61	*
0	3	3	8	(-1, 6)	9.21	(2, 10)	9.99	8.49	(4, 11)	10.81	17.36	8.87	
AVERAGE % ERROR IN TOTAL EXP.COST								3.40			3.96		
AVERAGE EXP.COST FOR EACH CASE					41.50		43.10			43.16			
TOTAL EXP.COST FOR EACH CASE					3983.71		4137.58			4143.46			
AVERAGE % ERROR DIFFERENCE MAC-POM												0.56	

COMPARISON OF OPT. POWER & NADDOR APPROXIMATIONS

VARIANCE-TO-MEAN RATIO = 9

*** ORDERED BY NADDOR APPROXIMATION ERROR ***

IN THIS TABLE SET-UP COSTS ARE: 32 AND 64

EXP.COST IS EXP. TOTAL COST

L	M	PI	K	OPTIMAL POLICY (S,S)	OPTIMAL POLICY EXP.COST	POWER APPROXIMATION (S,S)	POWER APPROXIMATION EXP.COST	POWER APPROXIMATION ERROR	NADDOR APPROXIMATION (S,S)	NADDOR APPROXIMATION EXP.COST	NADDOR APPROXIMATION ERROR	COMPARISON NAD-POW	COMPARISON ND<PW
0	11	27	32	(21, 47)	45.75	(21, 48)	45.77	0.04	(21, 46)	45.76	0.02	-0.02	*
2	3	27	32	(21, 38)	35.49	(21, 38)	35.49	0.0	(21, 37)	35.50	0.02	0.02	
2	7	27	64	(36, 69)	56.61	(35, 69)	56.62	0.02	(36, 68)	56.63	0.03	0.01	
4	3	27	64	(29, 53)	45.08	(29, 53)	45.08	0.0	(29, 52)	45.10	0.06	0.06	
2	3	27	64	(19, 42)	39.26	(18, 41)	39.29	0.10	(19, 43)	39.28	0.06	-0.04	*
0	15	27	32	(26, 55)	52.35	(26, 57)	52.38	0.06	(27, 54)	52.39	0.07	0.02	
0	7	27	32	(15, 37)	37.65	(15, 37)	37.65	0.0	(15, 38)	37.68	0.08	0.08	
0	15	81	64	(34, 76)	73.07	(33, 77)	73.15	0.11	(33, 76)	73.14	0.10	-0.01	*
0	15	27	64	(23, 66)	62.53	(23, 67)	62.55	0.03	(25, 67)	62.64	0.16	0.14	
2	11	27	64	(51, 92)	69.16	(50, 91)	69.20	0.06	(52, 89)	69.27	0.16	0.10	
4	3	27	32	(31, 49)	41.46	(32, 49)	41.47	0.03	(31, 47)	41.55	0.22	0.20	
2	15	27	64	(66, 112)	79.51	(65, 112)	79.53	0.02	(67, 108)	79.72	0.26	0.23	
0	11	81	64	(28, 65)	64.08	(27, 65)	64.14	0.09	(26, 66)	64.29	0.33	0.24	
4	7	27	64	(56, 91)	64.96	(55, 90)	65.00	0.06	(56, 87)	65.18	0.34	0.28	
0	11	27	64	(18, 55)	54.30	(18, 56)	54.30	0.01	([illegible], 58)	54.50	0.38	0.37	
2	7	27	32	(38, 63)	50.50	(38, 62)	50.51	0.02	(38, 59)	50.73	0.46	0.44	
4	11	27	64	(81, 124)	79.42	(80, 123)	79.44	0.02	(82, 118)	79.81	0.49	0.47	
0	15	3	64	(1, 45)	41.92	(0, 44)	41.93	0.02	(3, 48)	42.14	0.54	0.52	
0	7	27	64	(13, 43)	44.27	(13, 44)	44.27	0.01	(14, 47)	44.52	0.56	0.55	
0	7	81	64	(21, 52)	53.14	(20, 51)	53.25	0.20	(19, 54)	53.45	0.58	0.38	
4	7	27	32	(59, 85)	59.11	(60, 85)	59.14	0.05	(59, 80)	59.46	0.60	0.54	
4	15	27	64	(105, 154)	91.36	(103, 152)	91.45	0.09	(106, 146)	91.96	0.65	0.56	
2	11	27	32	(54, 84)	61.29	(54, 83)	61.30	0.01	(55, 78)	61.77	0.78	0.77	
2	15	27	32	(70, 103)	70.18	(70, 103)	70.18	0.0	(70, 96)	70.72	0.78	0.78	
2	15	9	64	(49, 97)	64.81	(49, 96)	64.83	0.03	(54, 95)	65.35	0.83	0.81	
2	7	9	64	(23, 58)	45.18	(23, 57)	45.19	0.01	(27, 59)	45.56	0.84	0.83	
2	11	9	32	(40, 70)	48.29	(41, 70)	48.32	0.05	(44, 69)	48.71	0.86	0.81	
2	11	9	64	(36, 79)	55.95	(36, 77)	55.97	0.04	(41, 78)	56.45	0.89	0.85	
4	11	9	64	(63, 108)	63.87	(63, 106)	63.90	0.06	(68, 105)	64.45	0.91	0.85	
2	15	81	64	(81, 126)	93.63	(81, 128)	93.65	0.02	(78, 119)	94.48	0.91	0.89	
0	11	3	64	(-1, 37)	35.85	(-3, 35)	35.95	0.29	(1, 41)	36.19	0.96	0.67	
2	7	9	32	(26, 51)	39.19	(27, 51)	39.21	0.04	(30, 51)	39.58	1.00	0.95	
0	15	9	64	(12, 55)	52.01	(12, 56)	52.02	0.02	(16, 58)	52.54	1.01	0.99	
4	15	9	64	(85, 136)	73.95	(84, 133)	74.03	0.11	(90, 131)	74.70	1.02	0.91	
2	15	9	32	(53, 88)	55.77	(54, 87)	55.78	0.03	(58, 85)	56.34	1.03	1.00	
0	11	9	32	(11, 37)	36.24	(12, 39)	36.32	0.23	(14, 39)	36.61	1.03	0.80	
0	15	9	32	(15, 45)	41.97	(16, 47)	42.03	0.14	(19, 46)	42.40	1.04	0.89	
0	3	27	32	(8, 23)	26.11	(8, 23)	26.11	0.0	(9, 26)	26.39	1.06	1.06	
4	7	9	64	(41, 78)	51.65	(41, 76)	51.68	0.06	(46, 77)	52.19	1.06	0.99	
2	11	81	64	(65, 105)	82.01	(64, 105)	82.03	0.02	(61, 99)	82.90	1.08	1.05	
0	3	81	64	(13, 35)	37.80	(12, 34)	37.89	0.24	(11, 38)	38.22	1.10	0.87	
4	11	27	32	(84, 116)	71.91	(85, 115)	71.93	0.02	(85, 108)	72.71	1.11	1.09	
2	7	81	64	(48, 81)	67.96	(47, 81)	67.97	0.01	(44, 76)	68.75	1.16	1.15	
2	15	3	64	(31, 82)	49.94	(31, 78)	50.10	0.32	(37, 82)	50.53	1.17	0.85	
4	3	9	64	(18, 43)	34.79	(19, 43)	34.79	0.02	(22, 45)	35.22	1.23	1.22	
4	11	9	32	(67, 100)	56.62	(69, 99)	56.70	0.15	(72, 96)	57.32	1.24	1.10	
0	3	81	32	(15, 31)	33.82	(13, 28)	34.17	1.04	(12, 31)	34.24	1.25	0.21	
4	7	9	32	(44, 71)	45.97	(46, 71)	46.03	0.12	(49, 69)	46.56	1.28	1.16	
4	15	27	32	(109, 144)	82.47	(110, 145)	82.50	0.04	(110, 135)	83.53	1.29	1.25	

0	11	81	32	(31, 57)	55.51	(30, 57)	55.51	0.02	(27, 53)	56.31	1.45	1.43
0	11	9	64	(8, 46)	44.73	(8, 46)	44.73	0.0	(12, 50)	45.39	1.49	1.49
4	15	9	32	(89, 127)	65.40	(91, 126)	65.45	0.08	(95, 121)	66.38	1.51	1.43
4	15	81	64	(123, 170)	107.86	(124, 173)	107.95	0.08	(119, 159)	109.49	1.51	1.43
0	7	81	32	(24, 46)	46.55	(22, 44)	46.68	0.29	(20, 43)	47.28	1.56	1.27
4	11	81	64	(97, 139)	94.31	(98, 141)	94.39	0.08	(93, 129)	95.81	1.59	1.51
2	3	9	32	(12, 29)	26.50	(13, 30)	26.59	0.33	(15, 31)	26.96	1.71	1.38
2	11	3	64	(21, 65)	42.82	(20, 61)	42.99	0.40	(27, 66)	43.56	1.73	1.33
0	15	81	32	(37, 66)	62.81	(36, 67)	62.87	0.10	(33, 61)	63.91	1.74	1.64
4	3	9	32	(21, 39)	31.22	(22, 39)	31.27	0.17	(25, 40)	31.77	1.76	1.59
4	15	3	64	(62, 118)	56.09	(64, 113)	56.31	0.38	(71, 115)	57.16	1.50	1.52
4	7	81	64	(70, 104)	77.94	(70, 105)	77.94	0.00	(65, 97)	79.43	1.91	1.91
2	3	81	64	(28, 51)	48.59	(27, 50)	48.68	0.18	(24, 49)	49.53	1.92	1.74
4	7	3	64	(25, 64)	38.48	(26, 61)	38.60	0.30	(3[illegible], 65)	39.25	1.98	1.68
2	15	3	32	(36, 73)	41.39	(38, 71)	41.51	0.30	(4[illegible], 72)	42.22	2.00	1.70
2	7	3	64	(11, 47)	34.15	(10, 44)	34.23	0.23	(16, 49)	34.84	2.02	1.79
0	15	3	32	(4, 35)	32.15	(4, 35)	32.15	0.0	(9, 38)	32.81	2.03	2.03
4	11	3	64	(44, 92)	48.14	(45, 88)	48.29	0.32	(52, 91)	49.16	2.12	1.80
0	3	27	64	(6, 27)	30.15	(7, 29)	30.26	0.36	(8, 33)	30.89	2.42	2.06
0	7	9	64	(4, 35)	35.83	(4, 35)	35.83	0.0	(6, 40)	36.71	2.45	2.45
4	15	3	32	(68, 109)	48.09	(72, 107)	48.33	0.51	(77, 106)	49.27	2.46	1.95
0	7	9	32	(6, 28)	29.20	(7, 29)	29.22	0.08	([illegible], 32)	29.92	2.47	2.40
0	7	3	64	(-3, 27)	28.47	(-5, 26)	28.66	0.64	(0, 33)	29.18	2.48	1.84
2	3	9	64	(10, 33)	30.25	(10, 33)	30.25	0.0	(14, 36)	31.02	2.56	2.56
2	15	81	32	(85, 117)	84.10	(87, 120)	84.36	0.31	(80, 106)	86.28	2.60	2.29
2	11	3	32	(25, 57)	35.53	(27, 56)	35.64	0.32	(32, 58)	36.46	2.61	2.29
4	15	81	32	(127, 161)	98.74	(132, 167)	99.67	0.95	(122, 148)	101.31	2.61	1.66
4	3	81	64	(40, 64)	55.48	(39, 63)	55.52	0.08	(35, 59)	56.94	2.63	2.55
4	11	3	32	(48, 84)	41.32	(52, 82)	41.55	0.56	(57, 83)	42.41	2.64	2.08
0	11	3	32	(2, 29)	27.50	(1, 28)	27.51	0.01	(6, 32)	28.24	2.68	2.67
4	11	81	32	(100, 131)	86.63	(104, 134)	87.07	0.51	(96, 119)	89.06	2.81	2.30
2	7	3	32	(14, 40)	28.38	(15, 39)	28.44	0.18	(20, 42)	29.21	2.93	2.74
2	11	81	32	(68, 97)	74.01	(69, 98)	74.07	0.08	(63, 87)	76.20	2.97	2.89
2	7	81	32	(50, 74)	61.76	(51, 75)	61.79	0.05	(45, 67)	63.71	3.15	3.10
4	7	81	32	(73, 98)	71.98	(75, 100)	72.18	0.28	(69, 88)	74.32	3.26	2.97
4	7	3	32	(29, 58)	33.09	(32, 57)	33.24	0.47	(37, 58)	34.17	3.26	2.79
0	7	3	32	(-1, 21)	21.79	(0, 22)	21.84	0.23	(3, 25)	22.63	3.85	3.62
4	3	81	32	(42, 60)	51.83	(43, 60)	51.86	0.06	(37, 53)	53.84	3.87	3.81
2	3	81	32	(30, 47)	44.82	(29, 46)	44.90	0.16	(25, 42)	46.67	4.11	3.95
4	3	3	64	(8, 33)	25.15	(8, 32)	25.17	0.07	(14, 36)	26.20	4.17	4.10
4	3	3	32	(10, 29)	21.67	(12, 29)	21.76	0.38	(16, 32)	22.59	4.24	3.86
2	3	3	64	(1, 25)	22.15	(1, 24)	22.16	0.02	(6, 29)	23.09	4.24	4.22
0	3	3	64	(-4, 15)	18.32	(-5, 17)	18.46	0.77	(-1, 22)	19.44	6.11	5.33
0	3	9	32	(2, 16)	19.19	(3, 18)	19.38	0.99	(5, 22)	20.44	6.50	5.51
2	3	3	32	(3, 21)	18.42	(4, 21)	18.43	0.03	(9, 25)	19.66	6.73	6.70
0	3	9	64	(0, 20)	23.37	(1, 23)	23.53	0.68	(4, 28)	25.02	7.05	6.37
0	3	3	32	(-2, [illegible])	13.85	(-2, 13)	13.95	0.73	(1, 17)	15.30	10.52	9.79

AVERAGE % ERROR IN TOTAL EXP.COST — 0.18 — 1.84

AVERAGE EXP.COST PER EACH CASE — 50.58 — 50.66 — 51.36
TOTAL EXP.COST PER EACH CASE — 4855.51 — 4863.35 — 4930.50

AVERAGE % ERROR DIFFERENCE MAD-ECW — 1.66

SUMMARY-AVERAGE EXP.COST PER EACH CASE — 8839.62 — 9000.93 — 9073.56
SUMMARY-TOTAL EXP.COST PER EACH CASE — 46.04 — 46.88 — 47.26

TOTAL AVERAGE % ERROR IN TOTAL EXP.COST — 1.79 — 2.90

TOTAL AVERAGE % ERROR DIFFERENCE MAD-ECW — 1.11

APPENDIX D

Single-Item Policies and Costs

In this appendix, the listed items are ordered by the difference between Power Approximation and Naddor Approximation total cost, expressed as a percentage of optimal total cost.

COMPARISON OF OPT. POWER & WADDOP APPROXIMATIONS

VARIANCE-TO-MEAN RATIO = 1

**** ORDERED BY ERROR DIFFERENCE WAD-POW ****

IN THIS TABLE SET-UP COSTS ARE: 8 AND 16

EXP.COST IS EXP. TOTAL COST

L	M	PI	K	OPTIMAL POLICY (S,S)	OPTIMAL POLICY EXP.COST	POWER APPROXIMATION (S,S)	POWER APPROXIMATION EXP.COST	POWER APPROXIMATION ERROR	WADDOP APPROXIMATION (S,S)	WADDOP APPROXIMATION EXP.COST	WADDOP APPROXIMATION ERROR	COMPARISON WAD-POW	COMPARISON WD<PW
0	11	3	16	(5, 22)	16.79	(6, 13)	19.64	16.91	(6, 21)	16.94	0.86	-16.06	*
4	15	3	16	(68, 91)	23.17	(70, 81)	26.12	12.71	(71, 88)	23.75	2.51	-10.21	*
2	15	3	16	(38, 60)	21.51	(40, 50)	24.04	11.74	(40, 57)	21.99	2.23	-9.51	*
0	11	9	16	(9, 25)	19.47	(9, 15)	21.92	12.54	(11, 24)	20.09	3.15	-9.39	*
2	7	3	8	(18, 25)	11.60	(18, 24)	12.70	9.51	(20, 28)	12.10	4.31	-5.20	*
4	15	9	16	(76, 97)	28.69	(76, 86)	31.14	8.52	(78, 93)	29.78	3.78	-4.74	*
0	11	27	16	(14, 28)	21.70	(12, 17)	23.79	9.63	(14, 26)	22.80	5.07	-4.56	*
0	7	3	8	(3, 13)	9.96	(4, 9)	10.68	7.20	(5, 13)	10.29	3.23	-3.98	*
0	15	3	16	(8, 30)	19.57	(9, 18)	20.60	6.32	(9, 26)	20.08	2.62	-3.70	*
2	7	81	8	(28, 37)	19.59	(28, 31)	20.83	6.56	(29, 35)	20.24	3.28	-3.28	*
0	11	81	16	(14, 30)	23.64	(15, 18)	25.92	9.61	(17, 29)	25.26	6.85	-2.76	*
2	7	9	8	(22, 32)	14.55	(22, 27)	15.59	7.18	(24, 31)	15.33	5.36	-1.81	*
4	11	3	8	(51, 66)	16.12	(53, 60)	17.16	6.44	(54, 63)	16.89	4.79	-1.65	*
0	7	9	8	(6, 16)	11.96	(7, 10)	12.84	7.32	(8, 15)	12.67	5.89	-1.44	*
2	7	27	8	(25, 35)	17.19	(25, 29)	18.40	7.01	([illegible], 33)	18.17	5.68	-1.33	*
2	15	9	16	(45, 66)	26.10	(45, 54)	27.87	6.79	(47, 61)	27.66	5.99	-0.80	*
2	11	3	8	(29, 42)	14.53	(30, 37)	15.08	3.81	(31, 40)	15.02	3.40	-0.41	*
4	15	27	16	(82, 103)	33.56	(81, 91)	35.50	5.80	(84, 97)	35.38	5.44	-0.36	*
4	15	81	8	(89, 95)	31.41	(89, 94)	31.61	0.64	(90, 96)	31.50	0.28	-0.36	*
2	15	81	8	(55, 61)	26.34	(55, 60)	26.44	0.36	(56, 61)	26.35	0.01	-0.35	*
4	3	81	8	(21, 25)	15.08	(22, 29)	15.34	1.75	(22, 28)	15.32	1.61	-0.14	*
0	7	3	16	([illegible], 16)	13.51	(3, 17)	13.59	0.60	(3, 17)	13.59	0.60	0.0	
2	15	27	8	(51, 57)	23.40	(51, 57)	23.40	0.0	(53, 58)	23.41	0.07	0.07	
4	15	27	8	(84, 91)	27.66	(83, 91)	27.67	0.04	(86, 92)	27.78	0.44	0.40	
0	15	81	8	(20, 24)	18.97	(20, 24)	18.97	0.0	(22, 25)	19.05	0.45	0.45	
4	11	27	8	([illegible], 70)	24.73	(62, 68)	24.92	0.79	(64, 71)	25.04	1.26	0.47	
0	15	27	8	(18, 22)	17.13	(17, 22)	17.13	0.00	(19, 23)	17.22	0.48	0.48	
4	15	81	16	(87, 108)	37.92	(87, 94)	39.53	4.63	(89, 102)	39.76	5.12	0.49	
4	11	81	8	(66, 73)	28.07	(67, 72)	28.14	0.22	(68, 74)	28.32	0.89	0.67	
2	15	9	8	(46, 54)	20.10	(46, 54)	20.10	0.0	(48, 55)	20.27	0.84	0.84	
4	15	9	8	(78, 86)	23.51	(78, 86)	23.51	0.0	(80, 88)	23.74	0.96	0.96	
4	15	3	8	(71, 83)	18.91	(73, 81)	19.05	0.78	(74, 83)	19.25	1.82	1.04	
2	11	9	16	(33, 50)	22.45	(33, 51)	22.50	0.24	(34, 48)	22.74	1.30	1.06	
2	11	3	16	(27, 45)	18.53	(28, 46)	18.58	0.29	(29, 44)	18.79	1.39	1.10	
2	7	9	16	(21, 35)	18.08	(21, 36)	18.11	0.16	(22, 34)	18.31	1.28	1.12	
4	11	3	16	(49, 69)	19.99	(51, 69)	20.11	0.63	(52, 67)	20.38	1.97	1.34	
2	7	3	16	(16, 32)	14.88	(17, 32)	14.94	0.42	(18, 31)	15.16	1.88	1.46	
4	7	81	16	(43, 57)	26.26	(43, 59)	26.29	0.09	(45, 56)	26.72	1.75	1.66	
2	3	3	16	(6, 17)	9.80	(6, 16)	9.82	0.26	(7, 17)	9.99	1.93	1.67	
0	7	9	16	(5, 19)	15.72	(6, 20)	15.83	0.66	(7, 19)	16.10	2.39	1.73	
2	11	9	8	(34, 41)	18.21	(34, 40)	18.34	0.70	(36, 43)	18.66	2.46	1.76	
4	11	27	16	(61, 78)	28.38	(60, 78)	28.98	0.33	(63, 76)	29.49	2.12	1.79	
4	11	9	8	(57, 71)	20.65	(57, 65)	21.01	1.74	(60, 67)	21.39	3.59	1.86	
2	11	27	8	(38, 44)	21.14	(38, 43)	21.29	0.70	(40, 46)	21.71	2.69	1.99	
2	3	27	16	(11, 21)	13.80	(11, 21)	13.80	0.0	(12, 21)	14.07	2.00	2.00	
2	3	81	16	(13, 22)	15.50	(13, 23)	15.50	0.00	(14, 23)	15.84	2.21	2.21	
4	3	27	8	(19, 26)	13.12	(19, 26)	13.12	0.0	(20, 26)	13.41	2.21	2.21	
2	15	3	8	(40, 50)	16.56	(42, 50)	16.60	0.25	(43, 52)	16.98	2.53	2.27	
4	7	27	16	(40, 54)	23.27	(39, 54)	23.32	0.25	(42, 53)	23.86	2.57	2.32	

2	7	27	16	(24, 39)	20.84	(24, 39)	20.89	0.22	(26, 37)	21.39	2.65	2.43
0	3	3	16	(0, 10)	8.89	(0, 9)	8.93	0.42	(1, 10)	9.15	2.88	2.46
2	11	81	8	(41, 47)	23.79	(42, 46)	23.87	0.39	(43, 49)	24.46	2.86	2.47
4	7	3	16	(30, 47)	16.03	(31, 46)	16.09	0.40	(33, 46)	16.50	2.94	2.55
2	3	9	16	(8, 19)	11.93	(9, 19)	11.94	0.06	(10, 19)	12.25	2.62	2.56
2	7	81	16	(27, 40)	23.29	(27, 42)	23.38	0.44	(29, 40)	23.99	3.03	2.59
4	3	91	16	(20, 30)	17.46	(21, 31)	17.54	0.45	(22, 30)	17.99	3.05	2.60
4	11	81	16	(65, 82)	32.57	(65, 83)	32.61	0.12	(67, 79)	33.46	2.74	2.62
4	11	9	16	(56, 74)	24.71	(56, 74)	24.71	0.0	(58, 71)	25.37	2.71	2.71
2	11	81	16	(40, 57)	28.85	(40, 58)	28.93	0.28	(42, 54)	29.74	3.06	2.78
4	7	91	8	(44, 54)	22.63	(45, 56)	22.88	1.07	(46, 52)	23.51	3.89	2.82
4	3	9	16	(15, 26)	13.09	(15, 25)	13.14	0.39	(17, 26)	13.51	3.24	2.85
0	7	27	8	(8, 18)	13.73	(9, 12)	14.21	3.50	(10, 16)	14.63	6.58	3.08
4	7	9	16	(36, 51)	19.88	(36, 51)	19.88	0.0	(38, 49)	20.50	3.12	3.12
0	3	9	16	(2, 11)	10.36	(2, 11)	10.36	0.0	(3, 12)	10.72	3.48	3.48
2	11	27	16	(37, 53)	25.85	(37, 55)	25.95	0.35	(39, 51)	26.86	3.87	3.52
4	3	3	16	(12, 24)	10.55	(12, 22)	10.64	0.86	(14, 23)	11.03	4.54	3.67
2	15	27	16	(50, 70)	30.06	(49, 57)	31.34	4.29	(52, 64)	32.52	8.18	3.90
0	3	81	8	(5, 11)	10.13	(5, 12)	10.17	0.40	(6, 12)	10.57	4.36	3.96
2	3	81	8	(13, 20)	13.02	(14, 21)	13.21	1.44	(15, 20)	13.75	5.55	4.11
0	15	9	8	(15, 20)	15.12	(14, 20)	15.12	0.00	(16, 22)	15.74	4.13	4.12
2	3	27	8	(11, 18)	11.43	(12, 19)	11.50	0.61	(13, 18)	11.98	4.82	4.21
0	7	81	8	(10, 19)	15.25	(11, 13)	15.79	3.52	(12, 18)	16.45	7.82	4.30
4	7	9	8	(37, 48)	16.49	(37, 48)	16.49	0.0	(39, 46)	17.20	4.30	4.30
4	3	27	16	(18, 28)	15.39	(18, 28)	15.39	0.0	(20, 28)	16.06	4.37	4.37
4	3	9	8	(16, 24)	10.90	(16, 23)	10.94	0.39	(18, 24)	11.43	4.81	4.42
4	3	3	8	(13, 21)	8.53	(13, 20)	8.63	1.22	(15, 21)	9.01	5.66	4.44
4	7	3	8	(32, 44)	12.90	(33, 44)	12.97	0.53	(35, 43)	13.60	5.36	4.83
0	7	27	16	(8, 20)	17.56	(8, 22)	17.65	0.49	(10, 21)	18.50	5.35	4.86
4	7	27	8	(41, 51)	19.74	(41, 52)	19.77	0.16	(43, 49)	20.73	5.05	4.88
0	15	3	8	(10, 18)	13.05	(11, 18)	13.05	0.00	(11, 20)	13.69	4.93	4.93
0	3	27	8	(4, 10)	9.09	(4, 11)	9.13	0.50	(5, 11)	9.58	5.44	4.93
0	11	3	8	(7, 14)	12.18	(7, 13)	12.21	0.22	(8, 17)	12.81	5.19	4.97
2	3	9	8	(9, 17)	9.61	(9, 16)	9.63	0.14	(11, 17)	10.10	5.13	4.99
0	15	9	16	(13, 33)	22.66	(13, 20)	23.08	1.87	(14, 28)	24.23	6.95	5.08
2	15	81	16	(54, 74)	33.50	(53, 60)	34.42	2.75	(56, 68)	36.17	7.98	5.22
0	3	3	8	(0, 3)	6.55	(1, 8)	6.59	0.63	(2, 8)	6.94	5.92	5.28
0	7	81	16	(10, 22)	19.19	(10, 24)	19.33	0.72	(12, 23)	20.35	6.03	5.31
0	3	27	16	(3, 13)	11.61	(4, 13)	11.77	1.37	(5, 14)	12.41	6.89	5.52
0	11	81	8	(15, 19)	17.46	(15, 18)	17.93	2.65	(17, 22)	19.01	8.86	6.21
0	11	27	8	(13, 17)	15.88	(13, 17)	15.88	0.0	(14, 20)	16.96	6.77	6.77
0	3	9	8	(2, 9)	7.86	(3, 10)	8.06	2.64	(4, 9)	8.60	9.49	6.85
2	3	3	8	(6, 15)	7.66	(7, 14)	7.68	0.28	(9, 15)	8.29	8.16	7.88
0	15	27	16	(16, 22)	25.12	(16, 22)	25.12	0.0	(18, 31)	27.58	9.80	9.80
0	11	9	8	(10, 15)	14.13	(10, 15)	14.13	0.0	(12, 19)	15.52	9.85	9.85
0	3	81	16	(5, 14)	12.80	(5, 14)	12.80	0.0	(7, 15)	14.25	11.29	11.29
0	15	91	16	(19, 24)	26.96	(19, 24)	26.96	0.0	(22, 33)	31.61	17.22	17.22
AVERAGE % ERROR IN TOTAL EXP.COST								2.17			4.05	
AVERAGE EXP.COST FOR EACH CASE					18.54		18.96			19.26		
TOTAL EXP.COST FOR EACH CASE					1779.46		1820.34			1849.33		
AVERAGE % ERROR DIFFERENCE NAD-POW												1.88

COMPARISON OF OPT. POWER & NADDOR APPROXIMATIONS

VARIANCE-TO-MEAN RATIO = 1

**** ORDERED BY ERROR DIFFERENCE NAD-POW ****

IN THIS TABLE SET-UP COSTS ARE: 32 AND 64

EXP.COST IS EXP. TOTAL COST

L	N	PI	K	OPTIMAL POLICY (S,S)	OPTIMAL POLICY EXP.COST	POWER APPROXIMATION (S,S)	POWER APPROXIMATION EXP.COST	POWER APPROXIMATION ERROR	NADDOR APPROXIMATION (S,S)	NADDOR APPROXIMATION EXP.COST	NADDOR APPROXIMATION ERROR	COMPARISON NAD-POW	COMPARISON ND<PW
0	3	3	64	(-3, 18)	17.17	(-1, 18)	17.52	2.08	(-2, 18)	17.27	0.59	-1.50	*
0	15	3	64	(2, 45)	38.25	(5, 42)	38.71	1.19	(1, 43)	38.32	0.18	-1.01	*
0	11	3	64	(0, 38)	32.82	(2, 35)	33.15	1.00	(0, 37)	32.82	0.02	-0.98	*
0	7	3	64	(-2, 29)	26.21	(0, 27)	26.53	1.23	(-1, 29)	26.27	0.25	-0.98	*
0	15	3	32	(5, 32)	27.20	(7, 34)	27.36	0.61	(6, 33)	27.22	0.08	-0.54	*
0	15	9	32	(12, 35)	30.67	(12, 39)	31.14	1.51	(13, 37)	30.97	0.98	-0.53	*
0	11	3	32	(3, 29)	23.45	(4, 27)	23.57	0.51	(3, 28)	23.45	0.00	-0.51	*
2	7	3	64	(12, 44)	27.00	(13, 42)	27.15	0.55	(12, 43)	27.01	0.05	-0.49	*
2	15	3	64	(31, 70)	39.43	(34, 74)	39.66	0.59	(32, 74)	39.48	0.12	-0.47	*
2	11	3	64	(21, 61)	33.80	(23, 58)	34.00	0.60	(22, 59)	33.85	0.16	-0.44	*
4	15	3	64	(61, 107)	40.52	(64, 106)	40.74	0.54	(62, 105)	40.58	0.15	-0.39	*
2	15	3	32	(35, 65)	28.89	(37, 66)	29.04	0.51	(36, 64)	28.93	0.14	-0.37	*
0	7	3	32	(0, 22)	18.73	(1, 20)	18.83	0.52	(1, 22)	18.76	0.16	-0.36	*
2	15	9	32	(43, 63)	33.89	(43, 72)	34.10	0.61	(44, 69)	33.99	0.29	-0.32	*
4	11	3	64	(43, 84)	34.73	(45, 82)	34.88	0.42	(44, 82)	34.79	0.16	-0.25	*
0	7	9	64	(3, 32)	29.33	(4, 31)	29.39	0.22	(4, 32)	29.36	0.12	-0.10	*
0	15	9	64	(10, 49)	42.70	(11, 48)	42.81	0.27	(11, 49)	42.78	0.20	-0.08	*
0	11	9	64	(7, 42)	36.74	(7, 40)	36.76	0.07	(7, 41)	36.74	0.01	-0.07	*
0	3	3	32	(-2, 13)	12.29	(0, 13)	12.53	2.01	(0, 14)	12.53	1.99	-0.02	*
2	7	3	32	(14, 37)	19.79	(15, 36)	19.84	0.29	(15, 36)	19.84	0.29	0.0	
4	7	3	64	(25, 59)	27.74	(27, 57)	27.89	0.50	(27, 57)	27.88	0.50	0.0	
4	15	27	32	(81, 105)	41.42	(80, 110)	41.70	0.67	(83, 106)	41.75	0.81	0.13	
4	15	3	32	(65, 95)	30.29	(67, 97)	30.41	0.41	(67, 95)	30.47	0.60	0.20	
2	15	27	32	(48, 72)	38.01	(48, 77)	38.45	1.15	(51, 73)	38.53	1.35	0.20	
2	11	3	32	(24, 52)	24.76	(26, 51)	24.87	0.44	(26, 50)	24.93	0.66	0.22	
4	11	3	32	(47, 75)	25.94	(48, 74)	26.04	0.36	(48, 73)	26.10	0.59	0.23	
2	15	9	64	(41, 82)	45.25	(41, 81)	45.26	0.00	(42, 80)	45.37	0.26	0.26	
2	3	3	64	(3, 25)	17.69	(3, 23)	17.75	0.36	(4, 25)	17.80	0.65	0.28	
4	15	9	32	(74, 101)	36.34	(74, 104)	36.42	0.21	(76, 100)	36.54	0.54	0.33	
4	15	9	64	(72, 114)	47.33	(72, 114)	47.33	0.0	(73, 111)	47.49	0.35	0.35	
2	7	9	64	(18, 49)	31.03	(18, 47)	31.04	0.05	(19, 47)	31.15	0.40	0.35	
4	7	3	32	(28, 52)	20.74	(29, 50)	20.84	0.48	(30, 51)	20.92	0.89	0.40	
4	15	81	32	(86, 110)	45.77	(85, 115)	46.27	1.09	(89, 111)	46.47	1.53	0.44	
4	7	9	64	(33, 63)	32.45	(32, 62)	32.48	0.11	(34, 62)	32.63	0.55	0.44	
4	3	3	64	(9, 31)	18.18	(9, 30)	18.21	0.17	(10, 31)	18.30	0.64	0.48	
0	11	9	32	(8, 32)	26.70	(8, 31)	26.71	0.04	(9, 31)	26.85	0.56	0.52	
2	11	9	64	(29, 66)	38.85	(29, 64)	38.89	0.10	(31, 64)	39.11	0.65	0.55	
4	11	9	64	(52, 90)	40.60	(52, 89)	40.60	0.01	(54, 87)	40.92	0.80	0.79	
0	15	27	32	(13, 39)	33.40	(16, 43)	34.26	2.56	(18, 41)	34.52	3.35	0.79	
2	3	9	64	(7, 27)	20.35	(7, 27)	20.35	0.0	(8, 28)	20.54	0.96	0.96	
2	15	81	32	(53, 76)	41.56	(52, 91)	42.18	1.49	(56, 78)	42.63	2.58	1.09	
4	7	9	32	(34, 56)	24.93	(34, 55)	24.95	0.07	(36, 55)	25.23	1.20	1.13	
2	7	9	32	(19, 40)	23.34	(19, 40)	23.34	0.0	(21, 40)	23.60	1.13	1.13	
4	15	27	64	(79, 119)	52.85	(78, 120)	52.92	0.13	(82, 118)	53.55	1.31	1.19	
4	11	27	64	(58, 94)	45.41	(57, 94)	45.54	0.30	(61, 93)	46.08	1.49	1.19	
4	11	9	32	(54, 81)	31.18	(54, 80)	31.18	0.00	(56, 78)	31.56	1.20	1.20	
2	11	9	32	(31, 57)	29.19	(31, 56)	29.19	0.01	(33, 55)	29.56	1.25	1.24	
2	3	3	32	(4, 20)	12.98	(5, 19)	13.05	0.56	(6, 20)	13.22	1.90	1.34	
4	3	3	32	(10, 27)	13.61	(11, 26)	13.65	0.31	(12, 26)	13.84	1.68	1.37	

[illegible]	[illegible]	[illegible]	[illegible]	([illegible], [illegible])	[illegible]	([illegible], [illegible])	[illegible]	[illegible]	([illegible], [illegible])	[illegible]	[illegible]	[illegible]
0	7	9	32	(4, 24)	21.32	(5, 24)	21.33	0.08	(6, 24)	21.63	1.48	1.40
2	11	27	64	(34, 70)	42.85	(34, 69)	42.86	0.02	(37, 70)	43.47	1.45	1.43
4	11	27	32	(60, 85)	35.68	(59, 85)	35.72	0.11	(62, 83)	36.25	1.60	1.49
2	15	27	64	(47, 86)	49.82	(46, 86)	49.88	0.11	(50, 86)	50.64	1.64	1.53
2	3	9	32	(8, 22)	15.33	(8, 22)	15.33	0.0	(9, 23)	15.57	1.53	1.53
2	11	27	32	(36, 60)	32.90	(35, 60)	32.96	0.16	(38, 59)	33.52	1.86	1.70
4	3	9	64	(13, 34)	21.29	(13, 34)	21.28	0.0	(15, 34)	21.64	1.71	1.71
4	7	27	64	(37, 67)	36.32	(37, 67)	36.32	0.0	(40, 67)	36.94	1.72	1.72
2	7	27	32	(23, 43)	26.30	(23, 44)	26.30	0.03	(25, 43)	26.79	1.86	1.83
4	7	27	32	(39, 60)	28.55	(38, 59)	28.59	0.14	(41, 59)	29.13	2.02	1.87
0	3	9	64	(0, 20)	19.22	(0, 19)	19.26	0.18	(2, 21)	19.65	2.22	2.03
4	11	81	32	(64, 85)	39.55	(64, 90)	39.56	0.03	(67, 87)	40.45	2.28	2.26
4	3	9	32	(14, 29)	16.39	(14, 29)	16.39	0.0	(16, 29)	16.77	2.26	2.26
2	11	81	32	(39, 64)	36.08	(39, 64)	36.08	0.0	(41, 63)	36.94	2.39	2.39
4	15	81	64	(84, 124)	57.53	(83, 125)	57.74	0.36	(89, 124)	59.15	2.81	2.45
4	3	27	32	(17, 32)	18.82	(17, 32)	18.82	0.0	(19, 32)	19.28	2.46	2.46
4	11	81	64	(63, 98)	49.46	(62, 99)	49.58	0.25	(67, 99)	50.94	2.99	2.74
4	7	81	32	(42, 63)	31.68	(42, 63)	31.69	0.0	(45, 62)	32.59	2.88	2.88
2	7	27	64	(22, 51)	34.23	(22, 51)	34.23	0.0	(25, 52)	35.23	2.91	2.91
0	7	27	32	(7, 26)	23.29	(7, 26)	23.29	0.0	(9, 27)	24.00	3.07	3.07
0	15	27	64	(14, 52)	45.83	(14, 51)	45.87	0.09	(18, 54)	47.32	3.27	3.18
2	3	27	32	(10, 24)	17.33	(10, 24)	17.33	0.0	(12, 25)	17.91	3.39	3.39
0	7	27	64	(6, 35)	31.53	(7, 34)	31.60	0.24	(9, 37)	32.70	3.72	3.48
2	15	81	64	(51, 90)	53.64	(51, 91)	53.66	0.04	(56, 92)	55.54	3.53	3.50
2	3	81	32	(12, 26)	19.07	(12, 26)	19.07	0.0	(14, 27)	19.75	3.51	3.51
0	15	81	32	(18, 40)	35.68	(18, 45)	36.51	2.32	(22, 44)	37.81	5.95	3.63
4	7	81	64	(41, 71)	39.59	(41, 71)	39.59	0.0	(45, 72)	41.05	3.69	3.69
4	3	27	64	(16, 37)	23.89	(16, 37)	23.89	0.0	(19, 37)	24.77	3.69	3.69
4	3	81	32	(20, 34)	20.95	(20, 35)	20.99	0.16	(22, 34)	21.85	4.26	4.10
0	11	27	32	(11, 35)	29.20	(11, 34)	29.20	0.02	(14, 35)	30.40	4.12	4.11
2	7	81	32	(26, 46)	28.85	(26, 47)	28.88	0.09	(29, 46)	30.09	4.29	4.20
2	3	27	64	(10, 30)	22.54	(9, 29)	22.55	0.03	(12, 31)	23.50	4.27	4.24
0	11	27	64	(10, 44)	39.46	(10, 43)	39.47	0.04	(14, 46)	41.20	4.40	4.37
2	11	81	64	(38, 73)	46.17	(38, 73)	46.17	0.0	(43, 75)	48.34	4.70	4.70
2	7	81	64	(25, 54)	36.93	(25, 54)	36.93	0.0	(29, 56)	38.71	4.84	4.84
0	3	9	32	(1, 15)	13.95	(1, 14)	13.98	0.22	(3, 16)	14.66	5.06	4.84
4	3	81	64	(19, 39)	26.08	(19, 40)	26.10	0.07	(22, 41)	27.43	5.20	5.13
0	3	27	64	(2, 22)	20.69	(3, 22)	20.79	0.44	(5, 24)	22.16	7.11	6.67
0	7	81	32	(9, 28)	24.96	(9, 28)	24.96	0.0	(12, 30)	26.63	6.69	6.69
0	3	27	32	(3, 16)	15.31	(3, 16)	15.31	0.0	(5, 18)	16.44	7.33	7.33
2	3	81	64	(12, 31)	24.35	(12, 32)	24.36	0.03	(15, 34)	26.21	7.64	7.61
0	11	81	32	(14, 37)	31.31	(14, 37)	31.31	0.0	(18, 38)	34.04	8.72	8.72
0	7	81	64	(8, 36)	33.34	(9, 36)	33.37	0.09	(13, 40)	36.36	9.06	8.96
0	15	81	64	(17, 55)	48.33	(17, 54)	48.35	0.04	(24, 60)	52.81	9.27	9.23
0	3	81	32	(4, 17)	16.49	(5, 18)	16.72	1.45	(7, 20)	18.33	11.25	9.81
0	11	81	64	(13, 46)	41.64	(13, 46)	41.64	0.0	(19, 51)	45.88	10.19	10.19
0	3	81	64	(4, 23)	21.90	(4, 23)	21.90	0.0	(8, 27)	25.07	14.47	14.47

AVERAGE % ERROR IN TOTAL EXP.COST			0.35		2.53	
AVERAGE EXP.COST PER EACH CASE	30.80	30.91		31.56		
TOTAL EXP.COST PER EACH CASE	2957.09	2967.16		3030.05		
AVERAGE % ERROR DIFFERENCE NAD-FOW						2.18
SUMMARY-AVERAGE EXP.COST PER EACH CASE	24.67	24.93		25.41		
SUMMARY-TOTAL EXP.COST FOR EACH CASE	4736.55	4787.50		4879.38		
TOTAL AVERAGE % ERROR IN TOTAL EXP.COST			1.26		3.29	
TOTAL AVERAGE % ERROR DIFFERENCE NAD-FOW						2.03

COMPARISON OF OPT. POWER & NADDOR APPROXIMATIONS

VARIANCE-TO-MEAN RATIO = 3

**** ORDERED BY ERROR DIFFERENCE NAD-POW ****

IN THIS TABLE SET-UP COSTS ARE: 8 AND 16

EXP.COST IS EXP. TOTAL COST

				OPTIMAL POLICY		POWER APPROXIMATION			NADDOR APPROXIMATION			COMPARISON	
L	M	PI	K	(S,S)	EXP.COST	(S,S)	EXP.COST	ERROR	(S,S)	EXP.COST	ERROR	NAD-POW	ND<PW
0	7	81	8	(15, 24)	22.19	(16, 17)	27.02	21.76	(15, 22)	22.38	0.87	-20.88	*
0	7	27	8	(11, 21)	18.66	(12, 15)	20.85	11.75	(13, 20)	18.89	1.24	-10.52	*
0	15	81	16	(25, 42)	36.10	(25, 30)	39.73	10.08	(26, 35)	36.32	0.63	-9.45	*
0	11	81	8	(21, 30)	26.67	(22, 24)	29.32	9.91	(21, 27)	27.00	1.23	-8.68	*
2	15	81	16	(64, 84)	47.58	(65, 71)	51.74	8.73	(65, 78)	48.21	1.32	-7.41	*
2	11	81	8	(51, 63)	37.14	(54, 55)	40.22	8.29	(51, 56)	37.87	1.99	-6.30	*
0	15	27	16	(20, 38)	31.49	(20, 27)	33.71	7.03	(22, 35)	31.94	1.43	-5.60	*
2	15	27	16	(57, 77)	40.95	(57, 66)	43.75	6.84	(59, 73)	41.52	1.41	-5.43	*
0	11	27	8	(17, 26)	22.65	(17, 21)	24.03	6.07	(18, 24)	22.92	1.17	-4.90	*
2	15	3	16	(39, 62)	26.17	(40, 53)	28.01	7.03	(43, 60)	26.85	2.62	-4.41	*
0	15	3	16	(8, 27)	21.44	(8, 20)	22.60	5.39	(10, 27)	21.67	1.05	-4.34	*
2	15	9	16	(49, 70)	33.78	(49, 63)	35.93	6.38	(52, 66)	34.67	2.64	-3.74	*
4	11	81	8	(79, 92)	44.36	(83, 84)	47.11	6.20	(80, 86)	45.53	2.63	-3.56	*
0	15	9	16	(14, 33)	26.60	(15, 24)	28.06	5.47	(17, 31)	27.12	1.93	-3.54	*
0	15	81	8	(27, 34)	29.91	(27, 33)	31.92	6.75	([illegible], 31)	30.92	3.38	-3.36	*
4	11	27	8	(74, 85)	37.47	(72, 78)	39.00	4.10	(73, 81)	38.00	1.43	-2.67	*
0	7	9	8	(7, 17)	15.03	(8, 13)	15.89	5.75	(10, 17)	15.55	3.45	-2.30	*
2	11	27	8	(45, 57)	31.38	(46, 51)	32.79	4.49	(47, 53)	32.15	2.44	-2.04	*
2	15	81	8	(66, 77)	42.40	(69, 71)	44.18	4.20	(66, 72)	43.42	2.39	-1.81	*
4	11	3	8	(53, 69)	22.26	(56, 64)	23.31	4.70	(57, 67)	22.92	2.95	-1.75	*
0	11	9	8	(12, 22)	18.46	(12, 18)	19.11	3.51	(14, 21)	18.80	1.87	-1.65	*
4	11	9	8	(63, 77)	30.03	(64, 71)	31.24	4.02	(66, 74)	30.78	2.48	-1.55	*
0	15	27	8	(22, 30)	25.55	(22, 27)	26.19	2.48	(23, 28)	25.82	1.06	-1.42	*
4	15	81	8	(103, 116)	50.94	(107, 109)	52.53	3.13	(103, 110)	51.85	1.80	-1.33	*
0	7	3	8	(3, 13)	11.47	(4, 13)	12.08	5.35	(6, 14)	11.97	4.38	-0.97	*
4	7	81	8	(55, 66)	36.32	(58, 70)	37.25	2.54	(55, 62)	36.93	1.66	-0.87	*
4	15	27	8	(94, 108)	43.17	(95, 102)	44.11	2.18	(96, 103)	43.87	1.63	-0.55	*
2	15	27	8	(59, 71)	36.02	(59, 66)	36.74	1.98	(61, 67)	36.54	1.45	-0.53	*
4	3	81	8	(29, 37)	25.29	(31, 39)	25.82	2.11	(28, 34)	25.74	1.78	-0.33	*
0	11	81	16	(20, 35)	31.40	(20, 38)	31.53	0.41	(20, 34)	31.44	0.13	-0.28	*
2	11	9	8	(38, 51)	25.26	(39, 46)	26.08	3.25	(41, 48)	26.01	2.97	-0.27	*
2	11	3	8	(30, 44)	18.91	(32, 40)	19.69	4.09	(34, 43)	19.64	3.83	-0.26	*
2	3	81	8	(19, 27)	21.46	(21, 29)	21.76	1.43	(19, 25)	21.74	1.30	-0.13	*
2	7	81	16	(35, 50)	33.80	(36, 52)	34.02	0.64	(35, 47)	34.02	0.65	0.01	
0	11	3	8	(7, 18)	14.25	(7, 15)	14.55	2.14	(9, 18)	14.56	2.16	0.02	
0	15	9	8	(16, 25)	21.01	(17, 24)	21.11	0.50	(18, 25)	21.12	0.54	0.04	
4	3	81	16	(26, 39)	27.22	(29, 40)	27.39	0.61	(27, 37)	27.40	0.66	0.05	
2	7	81	8	(36, 46)	30.54	(38, 49)	30.98	1.45	(36, 43)	31.00	1.51	0.06	
4	15	9	8	(84, 100)	34.75	(85, 94)	35.46	2.04	(88, 96)	35.48	2.11	0.07	
0	7	81	16	(14, 28)	25.76	(14, 29)	25.79	0.15	(15, 27)	25.83	0.30	0.15	
0	3	81	16	(8, 18)	17.98	(8, 18)	17.98	0.0	(8, 19)	18.02	0.21	0.21	
4	15	3	8	(73, 91)	25.87	(76, 85)	26.82	3.66	(78, 87)	26.88	3.90	0.24	
0	3	81	8	(9, 16)	15.81	(9, 16)	15.81	0.0	(9, 15)	15.85	0.25	0.25	
2	15	9	8	(51, 64)	29.15	(52, 60)	29.63	1.64	(54, 61)	29.71	1.90	0.26	
2	3	81	16	(19, 29)	23.49	(19, 30)	23.49	0.03	(18, 28)	23.57	0.35	0.31	
0	11	9	16	(10, 27)	22.91	(11, 29)	23.01	0.45	(12, 27)	23.09	0.80	0.35	
4	3	27	8	(24, 32)	20.92	(25, 33)	21.01	0.44	(25, 31)	21.13	0.99	0.55	
2	15	3	8	(41, 57)	21.95	(44, 53)	22.55	2.77	(46, 55)	22.68	3.34	0.57	
2	11	81	16	(50, 67)	41.33	(51, 70)	41.54	0.50	(50, 63)	41.79	1.10	0.60	

0	7	27	16	(10, 24)	22.16	(11, 26)	22.27	0.48	(12, 24)	22.40	1.10	0.62
0	7	9	16	(6, 20)	18.45	(7, 22)	18.54	0.49	(8, 21)	18.69	1.32	0.82
0	3	27	16	(5, 15)	15.09	(5, 15)	15.09	0.0	(6, 16)	15.22	0.86	0.86
4	3	27	16	(23, 35)	22.81	(23, 34)	22.81	0.02	(24, 33)	23.01	0.89	0.87
0	11	27	16	(15, 31)	27.26	(15, 33)	27.32	0.21	(17, 30)	27.56	1.09	0.88
4	11	81	16	(78, 96)	48.33	(79, 99)	48.56	0.47	(78, 91)	49.00	1.37	0.91
4	7	81	16	(53, 69)	39.43	(55, 71)	39.64	0.53	(54, 65)	40.00	1.45	0.92
2	3	27	16	(14, 26)	19.68	(15, 26)	19.69	0.02	(16, 25)	19.88	1.02	1.00
4	15	81	16	(101, 122)	55.69	(103, 126)	56.12	0.76	(102, 115)	56.67	1.76	1.00
2	7	27	16	(29, 45)	28.81	(29, 45)	28.81	0.0	(31, 43)	29.11	1.03	1.03
4	7	27	16	(47, 63)	33.49	(47, 63)	33.49	0.0	(48, 60)	33.89	1.18	1.18
0	3	27	8	(6, 13)	12.93	(6, 13)	12.93	0.0	(7, 13)	13.09	1.24	1.24
2	7	9	8	(25, 36)	20.47	(26, 37)	20.57	0.51	(27, 35)	20.83	1.75	1.24
2	11	27	16	(43, 61)	35.46	(43, 62)	35.46	0.01	(4[illegible], 58)	35.93	1.32	1.32
2	7	27	8	(31, 41)	25.65	(31, 42)	25.65	0.01	(32, 39)	26.01	1.43	1.41
0	11	3	16	(5, 22)	18.42	(5, 23)	18.42	0.02	(7, 23)	18.69	1.46	1.44
4	7	9	16	(39, 57)	27.15	(40, 56)	27.18	0.10	(42, 55)	27.57	1.55	1.44
4	7	27	8	(48, 60)	30.50	(49, 61)	30.55	0.16	(50, 57)	31.03	1.75	1.59
0	15	3	8	(10, 21)	16.37	(11, 20)	16.45	0.48	(13, 22)	16.71	2.09	1.61
4	3	9	8	(19, 28)	16.37	(20, 28)	16.47	0.56	(21, 27)	16.74	2.21	1.65
4	11	27	16	(70, 89)	41.29	(69, 89)	41.30	0.04	([illegible]2, 85)	41.99	1.71	1.67
4	15	27	16	(92, 114)	47.72	(92, 115)	47.74	0.05	(94, 108)	48.58	1.80	1.75
2	11	3	16	(27, 48)	22.50	(29, 48)	22.59	0.40	(31, 47)	23.00	2.21	1.81
2	3	27	8	(15, 23)	17.69	(16, 24)	17.72	0.12	(17, 22)	18.06	2.05	1.93
2	11	9	16	(36, 55)	29.13	(36, 55)	29.13	0.0	(39, 53)	29.71	1.98	1.98
4	3	9	16	(18, 30)	18.20	(18, 29)	18.22	0.13	(20, 29)	18.60	2.21	2.08
4	11	9	16	(61, 81)	33.66	(61, 81)	33.66	0.0	(64, 78)	34.39	2.16	2.16
2	7	9	16	(23, 39)	23.51	(23, 39)	23.51	0.0	(26, 38)	24.04	2.24	2.24
4	15	9	16	(82, 105)	39.03	(82, 105)	39.03	0.0	(85, 100)	39.93	2.31	2.31
4	7	3	16	(31, 50)	20.53	(32, 48)	20.66	0.63	(35, 49)	21.13	2.94	2.31
0	7	3	16	(2, 17)	14.73	(2, 17)	14.73	0.0	(4, 18)	15.08	2.34	2.34
4	11	3	16	(50, 73)	25.61	(52, 72)	25.72	0.44	(55, 71)	26.36	2.94	2.50
4	7	3	8	(33, 47)	17.68	(35, 47)	18.02	0.78	(37, 46)	18.47	3.33	2.56
4	7	9	8	(41, 54)	24.29	(42, 54)	24.33	0.16	(44, 51)	24.99	2.88	2.71
4	3	3	16	(12, 25)	13.53	(13, 24)	13.63	0.74	(15, 25)	14.00	3.48	2.75
4	15	3	16	(69, 95)	29.79	(72, 95)	29.92	0.44	(75, 92)	30.74	3.21	2.77
2	3	3	16	(5, 18)	11.88	(6, 17)	11.90	0.14	(8, 18)	12.25	3.10	2.95
0	3	9	16	(2, 12)	12.26	(3, 13)	12.36	0.83	(4, 14)	12.73	3.81	2.98
0	3	3	16	(-1, 10)	9.62	(0, 10)	9.67	0.52	(1, 11)	9.97	3.62	3.10
0	3	9	8	(3, 10)	10.11	(4, 11)	10.27	1.63	(5, 11)	10.59	4.77	3.14
2	7	3	16	(16, 34)	18.04	(17, 33)	18.08	0.22	(20, 33)	18.66	3.44	3.22
2	7	3	8	(18, 31)	15.20	(20, 31)	15.34	0.97	(22, 30)	15.88	4.48	3.50
2	3	9	16	(10, 22)	15.75	(10, 21)	15.76	0.04	(13, 22)	16.35	3.83	3.79
2	3	9	8	(11, 20)	13.83	(12, 20)	13.88	0.39	(14, 19)	14.48	4.70	4.32
4	3	3	8	(13, 23)	11.82	(15, 23)	11.98	1.28	(17, 23)	12.52	5.50	4.62
2	3	3	8	(7, 16)	10.05	(8, 16)	10.15	0.98	(10, 16)	10.69	6.42	5.44
0	3	3	8	(0, 8)	7.52	(1, 8)	7.59	1.04	(3, 9)	8.33	10.87	9.82
AVERAGE % ERROR IN TOTAL EXE.COST								2.30			2.17	
AVERAGE EXP.COST FOR EACH CASE					25.88		26.53			26.38		
TOTAL EXE.COST FOR EACH CASE					2484.92		2547.33			2532.65		
AVERAGE % ERROR DIFFERENCE SRC-ECW												-0.14

COMPARISON OF OPT. POWER & NADDCF APPROXIMATIONS

VARIANCE-TO-MEAN RATIO = 3

**** ORDERED BY ERROR DIFFERENCE NAD-POW ****

IN THIS TABLE SET-UP COSTS ARE: 32 AND 64

EXP.COST IS EXP. TOTAL COST

L	M	PI	K	OPTIMAL POLICY (S,S)	OPTIMAL POLICY EXP.COST	POWER APPROXIMATION (S,S)	POWER APPROXIMATION EXP.COST	POWER APPROXIMATION ERROR	NADDCF APPROXIMATION (S,S)	NADDCF APPROXIMATION EXP.COST	NADDCF APPROXIMATION ERROR	COMPARISON NAD-POW	COMPARISON ND<PW
0	15	3	64	(1, 45)	39.27	(2, 42)	39.38	0.29	(2, 45)	39.27	0.01	-0.28	*
0	11	3	64	(-1, 38)	33.65	(0, 35)	33.75	0.29	(0, 38)	33.67	0.04	-0.25	*
2	3	81	32	(16, 33)	26.63	(17, 32)	26.62	0.09	(18, 32)	26.60	0.02	-0.08	*
4	7	81	64	(50, 81)	51.33	(49, 81)	51.43	0.20	(51, 80)	51.40	0.13	-0.06	*
2	7	3	64	(11, 45)	29.06	(11, 42)	29.19	0.45	(13, 45)	29.18	0.40	-0.05	*
2	3	81	64	(17, 37)	31.31	(16, 38)	31.33	0.06	(17, 38)	31.32	0.03	-0.03	*
4	3	81	64	(25, 47)	34.79	(25, 48)	34.82	0.08	(26, 47)	34.81	0.06	-0.02	*
2	7	81	64	(34, 62)	46.14	(31, 62)	46.23	0.19	(33, 62)	46.22	0.18	-0.01	*
2	3	3	64	(2, 25)	19.03	(1, 23)	19.19	0.88	(4, 26)	19.20	0.91	0.02	
2	11	3	64	(21, 62)	36.39	(21, 59)	36.52	0.35	(23, 61)	36.54	0.40	0.05	
4	3	81	32	(27, 42)	30.23	(27, 43)	30.24	0.06	(27, 41)	30.26	0.13	0.07	
4	7	3	64	(25, 61)	30.96	(25, 57)	31.17	0.67	(28, 60)	31.20	0.75	0.08	
0	15	3	32	(5, 35)	28.65	(5, 34)	28.65	0.02	(6, 35)	28.68	0.12	0.10	
4	15	81	64	(97, 140)	73.50	(95, 140)	73.64	0.19	(98, 136)	73.72	0.30	0.11	
2	15	3	64	(31, 78)	42.45	(32, 76)	42.52	0.18	([illegible], 76)	42.60	0.36	0.17	
0	7	3	64	(-4, 29)	26.87	(-2, 27)	26.92	0.19	(-1, 30)	26.96	0.37	0.17	
4	11	81	64	(74, 111)	63.46	(73, 113)	63.51	0.08	(75, 109)	63.63	0.26	0.19	
2	7	81	32	(33, 55)	38.75	(33, 55)	38.75	0.0	(34, 53)	38.83	0.19	0.19	
0	15	9	32	(13, 40)	34.18	(13, 42)	34.23	0.13	(14, 40)	34.30	0.33	0.21	
4	7	27	64	(43, 75)	45.11	(42, 74)	45.22	0.24	(45, 74)	45.32	0.45	0.21	
0	15	9	64	(10, 51)	45.41	(10, 50)	45.43	0.04	(12, 51)	45.54	0.27	0.23	
4	15	27	64	(87, 131)	65.04	(85, 130)	65.24	0.30	(89, 127)	65.39	0.54	0.24	
2	11	81	64	(47, 83)	57.04	(46, 84)	57.05	0.02	(48, 82)	57.19	0.27	0.24	
2	11	81	32	(46, 74)	47.63	(46, 75)	47.66	0.05	(49, 71)	47.79	0.32	0.27	
2	7	27	64	(26, 57)	40.91	(25, 56)	41.02	0.29	(28, 57)	41.13	0.55	0.27	
2	7	27	32	(28, 50)	33.64	(27, 49)	33.69	0.15	(29, 48)	33.80	0.46	0.31	
0	11	3	32	(2, 29)	24.59	(2, 27)	24.63	0.15	(4, 29)	24.70	0.46	0.31	
4	11	27	64	(65, 104)	56.02	(64, 104)	56.10	0.14	(67, 101)	56.28	0.46	0.31	
2	15	81	32	(63, 91)	54.97	(62, 93)	55.04	0.12	(63, 87)	55.22	0.46	0.33	
0	11	81	32	(19, 42)	38.14	(19, 44)	38.19	0.14	(20, 43)	38.33	0.50	0.35	
4	11	3	64	(43, 87)	38.75	(43, 83)	38.90	0.37	(46, 84)	39.05	0.75	0.38	
4	3	27	32	(22, 38)	25.74	(21, 37)	25.78	0.14	(23, 37)	25.88	0.55	0.41	
4	7	81	32	(52, 74)	44.16	(52, 75)	44.17	0.03	(52, 71)	44.36	0.46	0.43	
0	7	3	32	(0, 22)	19.63	(0, 21)	19.64	0.03	(1, 23)	19.72	0.46	0.44	
4	15	3	64	(61, 111)	45.19	(62, 107)	45.36	0.38	(65, 108)	45.58	0.87	0.49	
0	7	9	64	(4, 33)	31.15	(3, 32)	31.19	0.12	(5, 35)	31.34	0.63	0.50	
4	11	9	64	(55, 96)	47.80	(54, 94)	47.91	0.22	(58, 93)	48.15	0.72	0.51	
2	15	27	64	(53, 95)	59.01	(52, 96)	59.03	0.04	(55, 93)	59.33	0.56	0.51	
2	15	81	64	(61, 102)	66.03	(60, 104)	66.08	0.08	(63, 100)	66.42	0.60	0.52	
4	11	81	32	(76, 102)	54.37	(76, 104)	54.40	0.07	(76, 98)	54.69	0.60	0.53	
4	7	27	32	(45, 68)	38.10	(44, 67)	38.20	0.24	(47, 66)	38.41	0.80	0.56	
2	11	27	32	(42, 68)	41.61	(41, 68)	41.62	0.01	(43, 65)	41.85	0.57	0.57	
4	3	27	64	(20, 42)	30.22	(20, 43)	30.23	0.04	(22, 42)	30.42	0.65	0.61	
0	3	81	32	(7, 21)	21.31	(7, 21)	21.31	0.0	(8, 23)	21.45	0.63	0.63	
4	7	9	64	(35, 68)	38.32	(34, 66)	38.46	0.35	(38, 67)	38.72	1.03	0.68	
2	15	27	32	(55, 84)	48.17	(54, 85)	48.23	0.12	(57, 81)	48.55	0.80	0.68	
2	11	27	64	(40, 77)	50.82	(39, 77)	50.83	0.01	(42, 76)	51.17	0.69	0.68	
0	11	9	64	(7, 43)	38.95	(7, 42)	38.96	0.03	(9, 44)	39.23	0.72	0.69	
2	15	9	64	(43, 87)	51.19	(43, 87)	51.19	0.0	(46, 85)	51.55	0.71	0.71	

[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
2	11	9	64	(31, 70)	43.97	(31, 69)	43.98	0.02	(34, 69)	44.30	0.75	0.72
0	15	81	32	(24, 50)	43.96	(24, 53)	44.09	0.28	(26, 49)	44.44	1.07	0.79
4	15	27	32	(90, 121)	54.61	(88, 120)	54.74	0.23	(92, 116)	55.17	1.02	0.79
2	3	27	32	(13, 29)	22.74	(13, 28)	22.75	0.05	(15, 29)	22.94	0.87	0.82
4	15	81	32	(99, 129)	62.79	(99, 131)	62.85	0.10	(100, 123)	63.38	0.94	0.84
2	11	9	32	(34, 61)	35.05	(34, 61)	35.05	0.0	(36, 59)	35.36	0.87	0.87
4	15	9	64	(76, 122)	55.64	(75, 120)	55.67	0.06	(79, 118)	56.15	0.93	0.87
2	7	9	64	(19, 51)	35.24	(19, 50)	35.26	0.06	(22, 51)	35.57	0.94	0.88
0	15	27	32	(19, 45)	39.27	(19, 48)	39.37	0.25	(21, 45)	39.72	1.14	0.88
0	11	27	32	(14, 38)	33.89	(14, 39)	33.91	0.06	(16, 38)	34.24	1.05	0.99
4	7	9	32	(37, 61)	31.58	(37, 60)	31.61	0.11	(40, 60)	31.93	1.11	1.00
4	3	9	64	(15, 37)	25.37	(14, 37)	25.41	0.16	(17, 38)	25.67	1.20	1.04
2	3	27	64	(14, 33)	27.37	(12, 34)	27.39	0.02	(14, 35)	27.67	1.07	1.05
0	7	81	32	(13, 33)	31.04	(13, 34)	31.05	0.06	(13, 34)	31.39	1.16	1.10
0	11	9	32	(9, 33)	29.39	(9, 34)	29.40	0.01	(11, 34)	29.73	1.16	1.15
2	15	3	32	(35, 69)	32.65	(36, 67)	32.69	0.14	(39, 67)	33.07	1.29	1.15
2	15	9	32	(46, 77)	40.72	(46, 77)	40.72	0.0	(49, 74)	41.19	1.15	1.15
2	7	3	32	(14, 38)	22.42	(14, 36)	22.52	0.45	(17, 38)	22.78	1.61	1.16
0	7	27	32	(9, 29)	27.38	(9, 30)	27.38	0.02	(11, 31)	27.70	1.18	1.16
4	11	9	32	(58, 87)	39.26	(58, 86)	39.28	0.05	(61, 84)	39.74	1.22	1.17
0	11	27	64	(13, 48)	43.67	(12, 47)	43.68	0.02	(15, 50)	44.21	1.22	1.20
2	11	3	32	(24, 54)	28.03	(25, 52)	28.09	0.22	(28, 53)	28.44	1.45	1.23
4	11	27	32	(68, 95)	47.15	(67, 95)	47.16	0.02	(70, 91)	47.75	1.27	1.24
4	15	9	32	(79, 112)	45.61	(78, 110)	45.66	0.11	(82, 107)	46.25	1.40	1.29
2	7	9	32	(21, 44)	28.18	(21, 43)	28.21	0.09	(24, 43)	28.57	1.39	1.30
4	15	3	32	(66, 102)	35.87	(67, 99)	35.99	0.32	(70, 98)	36.46	1.63	1.31
4	11	3	32	(47, 79)	30.80	(48, 76)	30.92	0.39	(51, 76)	31.34	1.75	1.36
0	15	27	64	(17, 57)	50.74	(17, 57)	50.74	0.0	(20, 58)	51.45	1.41	1.41
4	7	3	32	(28, 54)	24.65	(29, 52)	24.76	0.45	(32, 53)	25.12	1.91	1.46
4	3	3	64	(8, 32)	20.31	(8, 31)	20.33	0.14	(11, 33)	20.63	1.60	1.47
0	7	9	32	(5, 26)	23.56	(5, 26)	23.56	0.0	(7, 27)	23.92	1.52	1.52
4	3	3	32	(10, 28)	16.20	(10, 26)	16.30	0.60	(13, 28)	16.55	2.17	1.56
2	3	9	32	(9, 25)	18.73	(9, 24)	18.74	0.05	(11, 25)	19.04	1.67	1.62
2	3	9	64	(8, 29)	23.27	(7, 29)	23.30	0.13	(10, 30)	23.68	1.76	1.62
0	3	9	64	(0, 20)	20.44	(0, 20)	20.44	0.0	(2, 23)	20.84	1.95	1.95
0	15	81	64	(22, 62)	55.59	(22, 62)	55.59	0.0	(26, 64)	56.72	2.03	2.03
4	3	9	32	(16, 33)	21.02	(16, 32)	21.04	0.09	(19, 33)	21.48	2.15	2.06
0	3	3	64	(-3, 18)	17.57	(-3, 17)	17.57	0.02	(-1, 19)	17.97	2.29	2.28
0	3	27	32	(4, 18)	18.41	(5, 19)	18.46	0.30	(6, 21)	18.50	2.68	2.38
0	7	81	64	(12, 41)	38.81	(12, 41)	38.81	0.0	(15, 44)	39.75	2.43	2.43
0	7	27	64	(8, 37)	35.08	(8, 37)	35.08	0.0	(11, 40)	35.95	2.48	2.48
0	11	81	64	(17, 52)	48.00	(17, 52)	48.00	0.0	(21, 55)	49.24	2.57	2.57
0	3	3	32	(-2, 13)	12.82	(-1, 13)	12.87	0.39	(0, 15)	13.22	3.12	2.73
0	3	9	32	(1, 16)	15.54	(1, 15)	15.55	0.02	(3, 18)	16.00	2.94	2.92
2	3	3	32	(4, 21)	14.70	(4, 19)	14.77	0.46	(7, 22)	15.23	3.60	3.13
0	3	81	64	(6, 26)	26.28	(6, 26)	26.28	0.0	(9, 30)	27.24	3.66	3.66
0	3	27	64	(3, 23)	23.35	(4, 24)	23.37	0.06	(6, 27)	24.29	4.01	3.95

AVERAGE % ERROR IN TOTAL EXP.COST			0.15		1.07	
AVERAGE EXP.COST FOR EACH CASE	36.82	36.87		37.16		
TOTAL EXP.COST FOR EACH CASE	3534.39	3539.24		3567.32		
AVERAGE % ERROR DIFFERENCE MAD-ECW						0.92
SUMMARY-AVERAGE EXP.COST FOR EACH CASE	6019.30	6086.57		6099.97		
SUMMARY-TOTAL EXP.COST FOR EACH CASE	31.35	31.70		31.77		
TOTAL AVERAGE % ERROR IN TOTAL EXP.COST			1.23		1.62	
TOTAL AVERAGE % ERROR DIFFERENCE MAD-ECW						0.39

COMPARISON OF OPT. POWER & NADDOR APPROXIMATIONS

VARIANCE-TO-MEAN RATIO = 9

**** ORDERED BY ERROR DIFFERENCE NAD-POW ****

IN THIS TABLE SET-UP COSTS ARE: 8 AND 16

EXP.COST IS EXP. TOTAL COST

L	M	PI	K	OPTIMAL POLICY (S,S)	OPTIMAL POLICY EXP.COST	POWER APPROXIMATION (S,S)	POWER APPROXIMATION EXP.COST	POWER APPROXIMATION ERROR	NADDOR APPROXIMATION (S,S)	NADDOR APPROXIMATION EXP.COST	NADDOR APPROXIMATION ERROR	COMPARISON NAD-POW	COMPARISON ND<PW
0	15	81	16	(40, 59)	56.11	(40, 41)	70.16	25.04	(35, 50)	58.97	5.10	-19.94	*
0	11	81	8	(35, 48)	46.42	(32, 33)	58.38	25.77	(29, 37)	52.01	12.03	-13.73	*
0	15	27	16	(29, 49)	45.70	(29, 36)	50.53	10.57	(29, 44)	46.17	1.03	-9.54	*
0	11	27	8	(25, 38)	36.72	(26, 29)	40.11	9.25	(25, 32)	37.85	3.09	-6.15	*
2	11	27	8	(60, 75)	53.07	(63, 64)	57.51	8.37	(59, 67)	54.47	2.64	-5.73	*
4	11	81	8	(106, 121)	78.62	(104, 105)	87.58	11.39	(100, 108)	83.64	6.39	-5.01	*
2	11	81	8	(73, 88)	65.62	(71, 72)	75.02	14.33	(67, 74)	71.88	9.53	-4.79	*
4	11	27	8	(90, 106)	64.10	(94, 95)	68.59	7.01	(90, 98)	65.58	2.31	-4.69	*
0	15	9	16	(18, 39)	35.42	(20, 30)	37.32	5.35	(22, 38)	35.88	1.29	-4.06	*
0	15	81	8	(42, 55)	51.65	(40, 41)	62.29	20.13	(36, 42)	60.42	16.53	-3.61	*
2	15	27	8	(76, 92)	60.35	(80, 81)	64.27	6.49	(75, 82)	62.71	3.92	-2.58	*
4	11	3	8	(56, 75)	34.25	(65, 70)	36.17	5.61	(64, 73)	35.29	3.04	-2.57	*
0	15	27	8	(31, 45)	41.48	(33, 36)	44.65	7.63	(31, 37)	43.60	5.10	-2.53	*
4	11	9	8	(73, 91)	49.10	(80, 84)	51.18	4.24	(78, 86)	49.97	1.76	-2.47	*
2	15	81	8	(90, 106)	74.04	(89, 90)	82.97	12.05	([illegible], 51)	81.22	9.69	-2.36	*
4	3	9	8	(24, 34)	27.58	(29, 38)	28.42	3.05	(27, 34)	27.81	0.80	-2.24	*
2	11	9	8	(46, 61)	40.31	(50, 55)	41.92	3.97	(50, 58)	41.01	1.73	-2.24	*
4	15	27	8	(115, 133)	73.17	(121, 122)	76.92	5.13	(116, 123)	75.36	2.99	-2.14	*
4	15	3	8	(76, 98)	39.76	(87, 93)	41.63	4.71	(85, 95)	40.81	2.63	-2.08	*
4	15	81	8	(133, 150)	89.16	(132, 133)	97.42	9.26	(128, 134)	95.73	7.36	-1.89	*
0	11	9	8	(15, 28)	27.29	(18, 24)	28.17	3.25	(19, 27)	27.73	1.64	-1.61	*
4	15	9	8	(97, 116)	56.49	(103, 108)	58.42	3.42	(102, 110)	57.59	1.55	-1.48	*
4	7	3	8	(35, 51)	27.52	(43, 55)	28.71	4.32	(42, 51)	28.32	2.92	-1.40	*
4	3	3	8	(14, 24)	18.14	(20, 29)	19.28	6.29	(20, 27)	19.03	4.94	-1.35	*
2	11	3	8	(31, 48)	27.94	(38, 45)	29.05	3.98	(38, 48)	28.69	2.67	-1.31	*
2	15	9	8	(60, 77)	46.28	(65, 71)	47.70	3.06	(64, 72)	47.20	1.99	-1.07	*
0	15	9	8	(21, 35)	31.27	(23, 30)	32.06	2.52	(24, 32)	31.77	1.59	-0.93	*
2	7	3	8	(19, 33)	22.41	(25, 37)	23.30	3.96	(25, 34)	23.12	3.17	-0.79	*
2	15	3	8	(44, 63)	32.45	(51, 59)	33.56	3.42	(51, 61)	33.31	2.64	-0.78	*
0	7	9	8	(10, 21)	22.27	(13, 24)	22.74	2.12	(13, 22)	22.58	1.42	-0.70	*
0	3	27	8	(10, 19)	21.98	(12, 20)	22.15	0.79	(11, 18)	22.01	0.12	-0.67	*
2	3	9	8	(15, 24)	22.68	(18, 26)	23.04	1.61	(18, 25)	22.98	1.36	-0.25	*
4	3	27	8	(35, 45)	37.78	(39, 48)	38.46	1.81	(34, 40)	38.38	1.61	-0.21	*
4	7	9	8	(49, 64)	40.11	(55, 67)	40.77	1.66	(54, 61)	40.80	1.73	0.08	
0	7	27	16	(17, 32)	33.41	(17, 33)	33.41	0.02	(17, 31)	33.45	0.12	0.10	
0	15	3	16	(7, 29)	25.79	(9, 23)	26.54	2.89	(13, 31)	26.60	3.13	0.23	
2	7	9	8	(31, 44)	32.99	(35, 47)	33.50	1.55	(35, 42)	33.59	1.81	0.27	
0	3	27	16	(9, 20)	23.55	(10, 21)	23.60	0.23	(10, 22)	23.67	0.50	0.27	
2	3	27	16	(22, 35)	33.13	(23, 35)	33.13	0.02	(22, 33)	33.23	0.30	0.28	
0	11	27	16	(23, 41)	40.21	(24, 43)	40.29	0.20	(23, 38)	40.44	0.57	0.36	
4	7	27	8	(64, 78)	53.07	(69, 81)	53.81	1.39	(63, 71)	54.05	1.84	0.45	
4	3	27	16	(33, 46)	39.18	(35, 47)	39.28	0.26	(33, 43)	39.46	0.71	0.45	
4	3	9	16	(22, 36)	28.98	(25, 37)	29.16	0.62	(26, 36)	29.31	1.15	0.53	
2	3	9	16	(13, 26)	24.14	(16, 28)	24.44	1.24	(17, 27)	24.57	1.77	0.54	
2	3	27	8	(24, 33)	31.66	(26, 34)	31.81	0.47	(23, 30)	31.99	1.04	0.56	
4	7	9	16	(47, 67)	42.36	(51, 69)	42.71	0.82	(52, 65)	42.97	1.45	0.63	
2	11	9	16	(43, 65)	43.39	(46, 67)	43.63	0.54	(47, 62)	43.94	1.26	0.71	
2	7	27	16	(41, 59)	46.60	(42, 59)	46.65	0.10	(40, 54)	47.02	0.89	0.79	
0	11	9	16	(13, 32)	30.75	(15, 34)	30.52	0.56	(17, 32)	31.19	1.45	0.89	

0	7	27	8	(18, 30)	30.75	(20, 31)	30.88	0.42	(18, 26)	31.17	1.37	0.95
4	7	81	8	(77, 91)	65.81	(89, 101)	69.77	6.02	(71, 79)	70.40	6.98	0.96
2	7	9	16	(29, 47)	35.38	(31, 48)	35.52	0.41	(33, 46)	35.89	1.45	1.04
2	7	27	8	(43, 56)	44.16	(46, 58)	44.51	0.79	(42, 50)	45.00	1.90	1.11
4	7	27	16	(61, 80)	55.40	(64, 82)	55.57	0.32	(61, 74)	56.19	1.43	1.11
4	11	27	16	(87, 110)	67.12	(91, 112)	67.41	0.43	(88, 102)	68.24	1.68	1.25
2	15	9	16	(57, 82)	49.55	(60, 84)	50.19	0.48	(62, 77)	50.86	1.82	1.34
4	15	81	16	(130, 154)	92.87	(140, 164)	95.53	2.87	(125, 140)	96.82	4.26	1.39
4	7	3	16	(32, 54)	29.66	(38, 56)	30.24	1.96	(40, 54)	30.66	3.37	1.41
4	11	3	16	(52, 78)	36.98	(59, 80)	37.58	1.63	(61, 77)	38.11	3.05	1.42
4	11	9	16	(70, 94)	52.01	(74, 95)	52.22	0.41	(76, 90)	52.96	1.83	1.42
2	15	27	16	(73, 96)	64.15	(75, 99)	64.35	0.32	(73, 88)	65.28	1.76	1.44
2	11	27	16	(57, 78)	56.24	(59, 80)	56.37	0.23	(57, 71)	57.21	1.73	1.50
0	7	9	16	(8, 24)	24.94	(10, 26)	25.13	0.79	(12, 26)	25.51	2.31	1.52
4	15	27	16	(112, 138)	76.77	(116, 140)	77.05	0.37	(113, 128)	78.22	1.89	1.52
4	15	3	16	(72, 102)	42.98	(80, 104)	43.67	1.60	(82, 99)	44.33	3.15	1.55
2	3	3	8	(7, 16)	14.62	(11, 19)	15.32	4.79	(12, 19)	15.55	6.41	1.62
4	15	9	16	(93, 120)	59.93	(97, 121)	60.16	0.37	(99, 114)	61.13	2.00	1.62
2	15	3	16	(40, 67)	35.91	(45, 69)	36.30	1.11	(48, 66)	36.90	2.78	1.67
0	3	9	8	(4, 12)	14.90	(7, 15)	15.61	4.75	(8, 15)	15.86	6.43	1.68
2	11	3	16	(28, 52)	30.67	(33, 54)	31.28	1.33	(36, 52)	31.90	3.34	2.01
0	15	3	8	(10, 25)	21.75	(13, 23)	22.04	1.31	(10, 25)	22.49	3.39	2.07
4	11	81	16	(103, 125)	81.71	(112, 133)	83.88	2.65	(98, 112)	85.60	4.76	2.11
4	7	81	16	(75, 94)	68.18	(82, 100)	69.78	2.35	(70, 83)	71.29	4.56	2.21
2	7	3	16	(17, 36)	24.71	(20, 37)	24.96	0.98	(23, 37)	25.56	3.41	2.43
4	3	3	16	(12, 26)	19.49	(16, 28)	19.87	1.95	(18, 29)	20.36	4.45	2.49
0	11	3	16	(4, 23)	22.09	(6, 25)	22.25	0.74	(9, 26)	22.88	3.61	2.86
0	11	3	8	(6, 20)	18.68	(9, 18)	18.56	1.52	(12, 21)	19.50	4.42	2.90
0	3	81	16	(16, 28)	31.31	(15, 26)	31.49	0.59	(12, 25)	32.57	4.04	3.45
2	11	81	16	(71, 91)	68.86	(75, 96)	69.66	1.16	(65, 80)	72.33	5.04	3.88
0	7	81	16	(25, 41)	42.31	(25, 41)	42.31	0.0	(21, 36)	43.97	3.92	3.92
2	15	81	16	(88, 110)	77.94	(93, 117)	79.11	1.50	(82, 97)	82.17	5.42	3.93
4	3	81	8	(45, 55)	48.11	(52, 61)	49.83	3.57	(39, 46)	52.18	8.46	4.89
2	3	3	16	(5, 18)	16.06	(8, 20)	16.40	2.12	(11, 21)	17.21	7.13	5.01
0	3	9	16	(3, 13)	16.54	(5, 16)	16.95	2.45	(7, 18)	17.79	7.55	5.10
4	3	81	16	(44, 57)	49.53	(47, 59)	49.90	0.75	(38, 49)	52.51	6.01	5.26
0	11	81	16	(33, 51)	49.93	(33, 52)	49.95	0.03	(28, 43)	52.59	5.33	5.30
0	7	3	8	(3, 14)	14.81	(5, 16)	15.10	1.99	(8, 17)	15.89	7.30	5.32
2	7	81	16	(52, 70)	57.81	(55, 72)	58.07	0.45	(47, 60)	61.20	5.85	5.40
0	7	3	16	(1, 16)	17.50	(2, 18)	17.58	0.46	(6, 20)	18.58	6.17	5.71
2	3	81	16	(32, 44)	42.45	(33, 45)	42.51	0.13	(26, 38)	45.11	6.25	6.13
2	7	81	8	(54, 67)	55.34	(61, 73)	56.93	2.87	(48, 56)	60.40	9.14	6.27
0	3	81	8	(18, 26)	29.76	(17, 25)	29.81	0.18	(13, 21)	31.88	7.15	6.97
0	3	3	16	(-1, 8)	10.96	(0, 11)	11.34	3.43	(2, 13)	12.26	11.80	8.37
0	3	3	8	(-1, 6)	9.21	(2, 10)	9.99	8.49	(4, 11)	10.81	17.36	8.87
0	7	81	8	(27, 39)	39.65	(28, 39)	39.67	0.05	(22, 30)	43.55	9.82	9.77
2	3	81	8	(33, 43)	40.99	(36, 44)	41.25	0.65	(27, 34)	45.26	10.42	9.77

AVERAGE % ERROR IN TOTAL EXP.COST			3.40	3.96	
AVERAGE EXP.COST PER EACH CASE	41.50	43.10		43.16	
TOTAL EXP.COST FOR EACH CASE	3983.71	4137.58		4143.46	
AVERAGE % ERROR DIFFERENCE BAE-EOW					0.56

COMPARISON OF OPT. POWER & NADDOR APPROXIMATIONS

VARIANCE-TO-MEAN RATIO = 9

**** ORDERED BY ERROR DIFFERENCE NAD-POW ****

IN THIS TABLE SET-UP COSTS ARE: 32 AND 64

EXP.COST IS EXP. TOTAL COST

L	B	PI	K	OPTIMAL POLICY (S,S)	OPTIMAL POLICY EXP.COST	POWER APPROXIMATION (S,S)	POWER APPROXIMATION EXP.COST	POWER APPROXIMATION ERROR	NADDOR APPROXIMATION (S,S)	NADDOR APPROXIMATION EXP.COST	NADDOR APPROXIMATION ERROR	COMPARISON NAD-POW	COMPARISON ND<PW
2	3	27	64	(19, 42)	39.26	(18, 41)	39.29	0.10	(19, 43)	39.28	0.06	-0.04	*
0	11	27	32	(21, 47)	45.75	(21, 48)	45.77	0.04	(21, 46)	45.76	0.02	-0.02	*
0	15	81	64	(34, 76)	73.07	(33, 77)	73.15	0.11	(33, 76)	73.14	0.10	-0.01	*
2	7	27	64	(36, 69)	56.61	(35, 69)	56.62	0.02	(36, 68)	56.63	0.03	0.01	
0	15	27	32	(26, 55)	52.35	(26, 57)	52.38	0.06	(27, 54)	52.39	0.07	0.02	
2	3	27	32	(21, 38)	35.49	(21, 38)	35.49	0.0	(21, 37)	35.50	0.02	0.02	
4	3	27	64	(29, 53)	45.08	(29, 53)	45.08	0.0	(29, 52)	45.10	0.06	0.06	
0	7	27	32	(15, 37)	37.65	(15, 37)	37.65	0.0	(15, 38)	37.68	0.08	0.08	
2	11	27	64	(51, 92)	69.16	(50, 91)	69.20	0.06	(52, 89)	69.27	0.16	0.10	
0	15	27	64	(23, 66)	62.53	(23, 67)	62.55	0.03	(25, 67)	62.64	0.16	0.14	
4	3	27	32	(31, 49)	41.46	(32, 49)	41.47	0.03	(31, 47)	41.55	0.22	0.20	
0	3	81	32	(15, 31)	33.82	(13, 28)	34.17	1.04	(12, 31)	34.24	1.25	0.21	
2	15	27	64	(66, 112)	79.51	(65, 112)	79.53	0.02	(67, 108)	79.72	0.26	0.23	
0	11	81	64	(28, 65)	64.08	(27, 65)	64.14	0.09	(26, 66)	64.29	0.33	0.24	
4	7	27	64	(56, 91)	64.96	(55, 90)	65.00	0.06	(56, 87)	65.18	0.34	0.28	
0	11	27	64	(18, 55)	54.30	(18, 56)	54.30	0.01	(20, 58)	54.50	0.38	0.37	
0	7	81	64	(21, 52)	53.14	(20, 51)	53.25	0.20	(19, 54)	53.45	0.58	0.38	
2	7	27	32	(38, 63)	50.50	(38, 62)	50.51	0.02	(38, 59)	50.73	0.46	0.44	
4	11	27	64	(81, 124)	79.42	(80, 123)	79.44	0.02	(82, 118)	79.81	0.49	0.47	
0	15	3	64	(1, 45)	41.92	(0, 44)	41.93	0.02	(3, 48)	42.14	0.54	0.52	
4	7	27	32	(59, 85)	59.11	(60, 85)	59.14	0.05	(59, 80)	59.46	0.60	0.54	
0	7	27	64	(13, 43)	44.27	(13, 44)	44.27	0.01	(14, 47)	44.52	0.56	0.55	
4	15	27	64	(105, 154)	91.36	(103, 152)	91.45	0.09	(106, 146)	91.96	0.65	0.56	
0	11	3	64	(-1, 37)	35.85	(-3, 35)	35.95	0.29	(1, 41)	36.19	0.96	0.67	
2	11	27	32	(54, 84)	61.29	(54, 83)	61.30	0.01	(55, 78)	61.77	0.78	0.77	
2	15	27	32	(70, 103)	70.18	(70, 103)	70.18	0.0	(70, 96)	70.72	0.78	0.78	
0	11	9	32	(11, 37)	36.24	(12, 39)	36.32	0.23	(14, 39)	36.61	1.03	0.80	
2	15	9	64	(49, 97)	64.81	(49, 96)	64.83	0.03	(54, 95)	65.35	0.83	0.81	
2	11	9	32	(40, 70)	48.29	(41, 70)	48.32	0.05	(44, 69)	48.71	0.86	0.81	
2	7	9	64	(23, 58)	45.18	(23, 57)	45.19	0.01	(27, 59)	45.56	0.84	0.83	
4	11	9	64	(63, 108)	63.87	(63, 106)	63.90	0.06	(68, 105)	64.45	0.91	0.85	
2	11	9	64	(36, 79)	55.95	(36, 77)	55.97	0.04	(41, 78)	56.45	0.89	0.85	
2	15	3	64	(31, 82)	49.94	(31, 78)	50.10	0.32	(37, 82)	50.53	1.17	0.85	
0	3	81	64	(13, 35)	37.80	(12, 34)	37.89	0.24	(11, 38)	38.22	1.10	0.87	
2	15	81	64	(81, 126)	93.63	(81, 128)	93.65	0.02	(78, 119)	94.48	0.91	0.89	
0	15	9	32	(15, 45)	41.97	(16, 47)	42.03	0.14	(19, 46)	42.40	1.04	0.89	
4	15	9	64	(85, 136)	73.95	(84, 133)	74.03	0.11	(90, 131)	74.70	1.02	0.91	
2	7	9	32	(26, 51)	39.19	(27, 51)	39.21	0.04	(30, 51)	39.58	1.00	0.95	
0	15	9	64	(12, 55)	52.01	(12, 56)	52.02	0.02	(16, 58)	52.54	1.01	0.99	
4	7	9	64	(41, 78)	51.65	(41, 76)	51.68	0.06	(46, 77)	52.19	1.06	0.99	
2	15	9	32	(53, 88)	55.77	(54, 87)	55.78	0.03	(58, 85)	56.34	1.03	1.00	
2	11	81	64	(65, 105)	82.01	(64, 105)	82.03	0.02	(61, 99)	82.90	1.08	1.05	
0	3	27	32	(8, 23)	26.11	(8, 23)	26.11	0.0	(9, 26)	26.39	1.06	1.06	
4	11	27	32	(84, 116)	71.91	(85, 115)	71.93	0.02	(85, 108)	72.71	1.11	1.09	
4	11	9	32	(67, 100)	56.62	(69, 99)	56.70	0.15	(72, 96)	57.32	1.24	1.10	
2	7	81	64	(48, 81)	67.96	(47, 81)	67.97	0.01	(44, 76)	68.75	1.16	1.15	
4	7	9	32	(44, 71)	45.97	(46, 71)	46.03	0.12	(49, 69)	46.56	1.28	1.16	
4	3	9	64	(16, 43)	34.79	(19, 43)	34.79	0.02	(22, 45)	35.22	1.23	1.22	
4	15	27	32	(109, 144)	82.47	(110, 145)	82.50	0.04	(110, 135)	83.53	1.29	1.25	
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	

3	7	81	32	(24, 46)	46.55	(22, 44)	46.68	0.29	(20, 43)	47.28	1.56	1.27
2	11	3	64	(21, 65)	42.82	(20, 61)	42.59	0.40	(27, 66)	43.56	1.73	1.33
2	3	9	32	(12, 29)	26.50	(13, 30)	26.59	0.33	(15, 31)	26.96	1.71	1.38
4	15	9	32	(89, 127)	65.40	(91, 126)	65.45	0.08	(95, 121)	66.38	1.51	1.43
0	11	81	32	(31, 57)	55.51	(30, 57)	55.51	0.02	(27, 53)	56.31	1.45	1.43
4	15	81	64	(123, 170)	107.86	(124, 173)	107.95	0.08	(119, 159)	109.49	1.51	1.43
0	11	9	64	(8, 46)	44.73	(8, 46)	44.73	0.0	(12, 50)	45.39	1.49	1.49
4	11	81	64	(97, 139)	94.31	(98, 141)	94.39	0.08	(93, 129)	95.81	1.59	1.51
4	15	3	64	(62, 118)	56.09	(64, 113)	56.31	0.38	(71, 115)	57.16	1.90	1.52
4	3	9	32	(21, 39)	31.22	(22, 39)	31.27	0.17	(25, 40)	31.77	1.76	1.59
3	15	81	32	(37, 66)	62.81	(36, 67)	62.87	0.10	(33, 61)	63.91	1.74	1.64
4	15	81	32	(127, 161)	98.74	(132, 167)	99.67	0.95	(122, 148)	101.31	2.61	1.66
4	7	3	64	(25, 64)	38.48	(26, 61)	38.60	0.30	(32, 65)	39.25	1.98	1.68
2	15	3	32	(36, 73)	41.39	(38, 71)	41.51	0.30	(43, 72)	42.22	2.00	1.70
2	3	81	64	(28, 51)	48.59	(27, 50)	48.68	0.18	(24, 49)	49.53	1.92	1.74
2	7	3	64	(11, 47)	34.15	(10, 44)	34.23	0.23	(16, 49)	34.84	2.02	1.79
4	11	3	64	(44, 92)	48.14	(45, 88)	49.29	0.32	(52, 91)	49.16	2.12	1.80
0	7	3	64	(-3, 27)	28.47	(-5, 26)	28.66	0.64	(0, 33)	29.18	2.48	1.84
4	7	81	64	(70, 104)	77.94	(70, 105)	77.94	0.00	(65, 97)	79.43	1.91	1.91
4	15	3	32	(68, 109)	48.09	(72, 107)	48.33	0.51	(77, 106)	49.27	2.46	1.95
0	15	3	32	(4, 35)	32.15	(4, 35)	32.15	0.0	(9, 38)	32.81	2.03	2.03
0	3	27	64	(6, 27)	30.15	(7, 29)	30.26	0.36	(8, 33)	30.89	2.42	2.06
4	11	3	32	(48, 84)	41.32	(52, 82)	41.55	0.56	(57, 83)	42.41	2.64	2.08
2	15	81	32	(85, 117)	84.10	(87, 120)	84.36	0.31	(80, 106)	86.28	2.60	2.29
2	11	3	32	(25, 57)	35.53	(27, 56)	35.64	0.32	(32, 58)	36.46	2.61	2.29
4	11	81	32	(100, 131)	86.63	(104, 134)	87.07	0.51	(96, 119)	89.06	2.81	2.30
0	7	9	32	(6, 28)	29.20	(7, 29)	29.22	0.08	(10, 32)	29.92	2.47	2.40
0	7	9	64	(4, 35)	35.83	(4, 35)	35.83	0.0	(8, 40)	36.71	2.45	2.45
4	3	81	64	(40, 64)	55.48	(39, 63)	55.52	0.08	(35, 59)	56.94	2.63	2.55
2	3	9	64	(10, 33)	30.25	(10, 33)	30.25	0.0	(14, 36)	31.02	2.56	2.56
0	11	3	32	(2, 29)	27.50	(1, 28)	27.51	0.01	(6, 32)	28.24	2.68	2.67
2	7	3	32	(14, 40)	28.38	(15, 39)	28.44	0.18	(20, 42)	29.21	2.93	2.74
4	7	3	32	(29, 58)	33.09	(32, 57)	33.24	0.47	(37, 58)	34.17	3.26	2.79
2	11	81	32	(68, 97)	74.01	(69, 98)	74.07	0.08	(63, 87)	76.20	2.97	2.89
4	7	81	32	(73, 98)	71.98	(75, 100)	72.18	0.28	(68, 88)	74.32	3.26	2.97
2	7	81	32	(50, 74)	61.76	(51, 75)	61.79	0.05	(45, 67)	63.71	3.15	3.10
0	7	3	32	(-1, 21)	21.79	(0, 22)	21.84	0.23	(3, 25)	22.63	3.85	3.62
4	3	81	32	(42, 60)	51.83	(43, 60)	51.86	0.06	(37, 53)	53.84	3.87	3.81
4	3	3	32	(10, 29)	21.67	(12, 29)	21.76	0.38	(16, 32)	22.59	4.24	3.86
2	3	81	32	(30, 47)	44.82	(29, 46)	44.90	0.16	(25, 42)	46.67	4.11	3.95
4	3	3	64	(8, 33)	25.15	(8, 32)	25.17	0.07	(14, 36)	26.20	4.17	4.10
2	3	3	64	(1, 25)	22.15	(1, 24)	22.16	0.02	(6, 29)	23.09	4.24	4.22
0	3	3	64	(-4, 15)	18.32	(-5, 17)	18.46	0.77	(-1, 22)	19.44	6.11	5.33
0	3	9	32	(2, 16)	19.19	(3, 18)	19.38	0.99	(5, 22)	20.44	6.50	5.51
0	3	9	64	(0, 20)	23.37	(1, 23)	23.53	0.68	(4, 28)	25.02	7.05	6.37
2	3	3	32	(3, 21)	18.42	(4, 21)	18.43	0.03	(9, 25)	19.66	6.73	6.70
0	3	3	32	(-2, 11)	13.85	(-2, 13)	13.95	0.73	(1, 17)	15.30	10.52	9.79

AVERAGE % ERROR IN TOTAL EXP.COST			0.18		1.84	
AVERAGE EXP.COST FOR EACH CASE	50.58	50.66		51.36		
TOTAL EXP.COST FOR EACH CASE	4855.51	4863.35		4930.50		
AVERAGE % ERROR DIFFERENCE MAD-EOW						1.66
SUMMARY-AVERAGE EXP.COST FOR EACH CASE	8839.61	9000.93		9073.96		
SUMMARY-TOTAL EXP.COST FOR EACH CASE	46.04	46.88		47.26		
TOTAL AVERAGE % ERROR IN TOTAL EXP.COST			1.79		2.90	
TOTAL AVERAGE % ERROR DIFFERENCE MAD-EOW						1.11

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